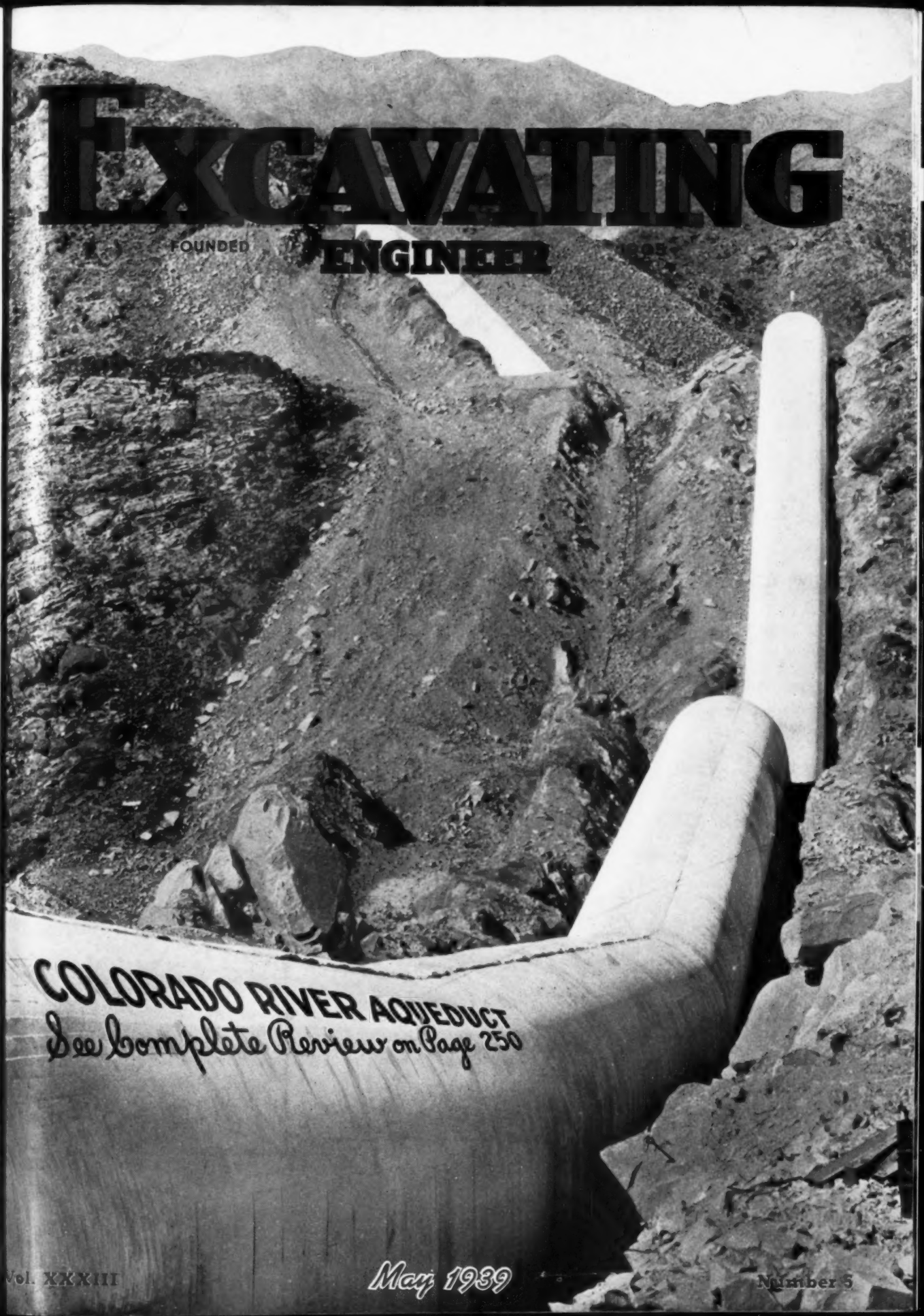

EXCAVATING
FOUNDED
ENGINEER
1905
COLORADO RIVER AQUEDUCT
See Complete Review on Page 250
Vol. XXXIII
May 1939
Number 5

HOW TO KEEP THE SAND-HOGS *happy*

We manufacture a complete line of Hand Sinkers, Paving Breakers, Pneumatic Diggers and Tampers, Wagon Drills, and Miscellaneous Accessories.

• Deep under the earth's surface, sometimes with the river flowing its muddy, turbulent way a hundred feet or so above his head—in dank darkness, lighted by a few quivering electric bulbs, or his own flickering miner's lamp — always in discomfort from trickling water and crowding quicksand—daily subject to the dangers that are an inseparable part of his chosen occupation — the worker we call a "sand-hog" finds in his shift little enough of cheer. It helps a lot if his tools are right. He needs the fast, easy-holding Cleveland CD8 to help him get his bonus. The CD8 tires him less, and doesn't slow him up by breaking down on the job. The CD8 is a real friend to the sand-hog.

And a friend it is also to the contractor. The CD8 gets more work done with less cost for compressed air and less expense for repairs. It's built to stay on the job, where a clay digger belongs. Either inside or outside trigger provided, or the extended trench-digger handle. Demonstration on your own job, with your own operators, any time. Bulletin on request.

BRANCH OFFICES

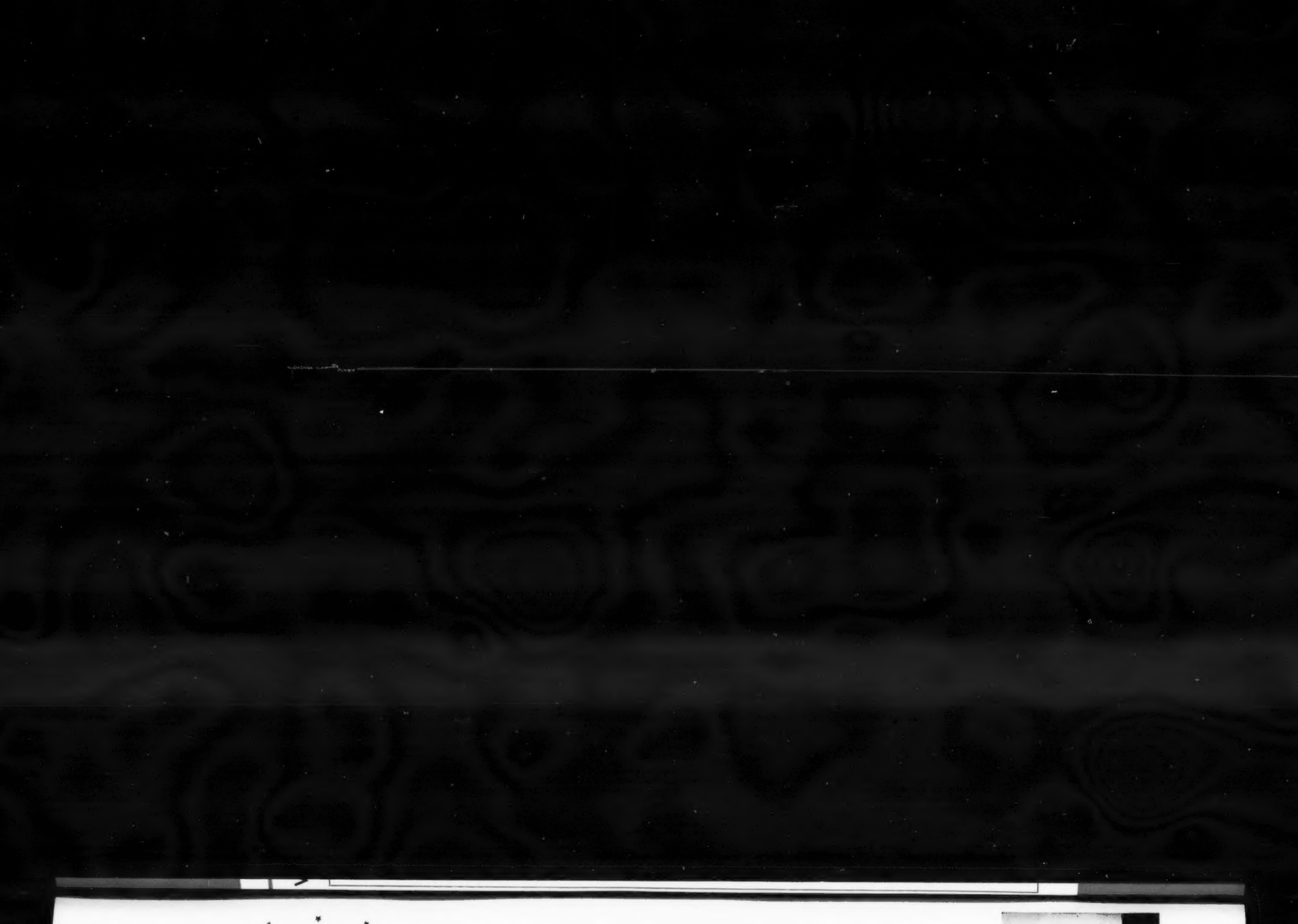
Birmingham, Ala.
1306-8 North First Ave.
Butte, Mont.
41 East Broadway
El Paso, Texas
1417 Texas Street
Ironwood, Mich.
715 Sunset Road
Denver, Colo.
1835 S. Emerson St.
Newton Highlands, Mass.
130 Needham St.
Los Angles, Calif.
821 Santa Fe Ave.
Winchester, Ky.
10 French Ave.
New York, New York
200 Church Street
Richmond, Va.
12 North 15th St.
Salt Lake City, Utah
418 Dooly Bldg.

THE CLEVELAND ROCK DRILL COMPANY

3734 EAST 78TH STREET • CLEVELAND, OHIO

Cable Address: ROCKDRILL

LEADERS IN DRILLING EQUIPMENT



V

EXCAVATING ENGINEER

FOUNDED 1905

contents

Vol. XXXIII **May, 1939** No. 5

Colorado River Aqueduct—a review—By John R. Marcy . . . 250

Man completes another outstanding engineering feat in the construction of this $200,000,000 aqueduct that will carry water over 400 miles.

Pushing 'em Over with a Bullgrader—By Kenneth Force . . . 257

A Bucyrus-Erie Bullgrader mounted on an International TD40 TracTracTor hangs up a real record in tree clearing performance.

Moving 2,000,000 Yards on the Albert Canal 260

Another step towards the final completion of the largest canal in Europe.

Field Notes 262

Wrenches for Excavating.. 262
Study Reduces Belting Costs 262
Metal Cover for Cement Truck 262
Hole in Track Shoe to Tighten Nuts 262
Must Bidder "X-Ray" Site? 263
Convenient Cement "Knocker" 263
Truck Turntable 263
Cleaning Heavy Chain 294
Tunnel Loading Trucks 294
1938 Accident Record 294

Editorial 264

Residential Construction at High Level 264
The Competitive System 265

Equipment You Ought to Know About 266

Cable Controls 266
Passenger All-Wheel Drive 266
New Diesel Oil 266
High Pressure Hose 266
Improved Conveyor Belt .. 266
All Angle Milling 266
Dodge Trucks 266
Prefabricated Concrete Units 267
Worthington Diesel 267
Jackbit Grinder 267
Portable Compressors 267
24-Yard Scraper 302
Improved Cord Air Hose .. 302

Not In the Contract 268

Shots from the Firing Line 270

Unique Ditch Digger 270
Tin Mining on Island of Banka 270
Increase Housing Loans . . . 274
Ft. Peck Gets Early Start 274
Low Pennsylvania Tunnel Bids 276
Complete Shasta Dam Railroad Tunnel 276
Owyhee Irrigation Canals.. 280
Beavers Aid Conservation...280
Obituary—H. B. Blanks . . . 280

Ex-Laffs 296

Book Reviews 300

Trade Notes 300

Advertiser's Index

American Chain & Cable Company . . . . . 3rd Cover
American Steel and Wire Company 245
Atlas Imperial Diesel Engine Company 272-273
Austin-Western Road Machinery Company, The 283
Bargain Counter 304
Bethlehem Steel Company 281
Brooks Equipment and Manufacturing Company 293
Bucyrus-Erie Company . . . . . 242, 276, 291, 297, 301, 4th Cover
Bucyrus-Erie Company, Tractor Equipment Division 271
Bucyrus-Monighan Company . . 285
Caterpillar Tractor Company . . 277
Cleveland Rock Drill Company . . . . . 2nd Cover
Columbia Steel Company 245
Ensign-Bickford Company, The 248
For Sale Advertisements 303
Gatke Corporation 280
General Electric 275
Haiss Manufacturing Company, George 269
Hayward Company, The 298
Hazard Wire Rope Division, American Chain & Cable Company . . . . . 3rd Cover
Hercules Powder Company . . . 289
Homelite Corporation 300
Ingersoll-Rand Company 244
International Harvester Company, The 249
Koehring Company 241
Leschen and Sons Rope Company, A. 302
Nation's Business 299
Macwhyte Company 287
Owen Bucket Company. 298
Positions Wanted Advertisements 304
Roebling's Sons Company, John A. 293
Rogers Brothers Corporation . . 295
Sauerman Brothers 295
Socony-Vacuum Oil Company, Inc. 246-247
Standard Oil Company of California 278-279
United States Steel Corporation Subsidiaries 245
Wellman Engineering Company, The 295
Whitcomb Locomotive Company, The 293

Published Monthly by THE EXCAVATING ENGINEER PUBLISHING COMPANY, South Milwaukee, Wisconsin, U.S.A.

F. O. WYSE, *Manager* — ARNOLD ANDREWS, *Managing Editor*
D. B. REED, JR., *Editor* — M. J. BARGENQUEST, *Assistant Editor*
JOHN I. MORAVEC, *Art Director* — DELMAR COHEN, *Assistant Editor*
E. M. HEUSTON, *Advertising Manager* — H. J. MASUHR, JR., *Assistant Editor*

CCA Member Controlled Circulation Audit

Regular subscription: 25 cents per copy, $2.50 a year; Canada and foreign, subject to publication policy, $3.50 per year. Special subscription: Upon application on card inserted in this number this publication will be sent frequently (not regularly) free of charge, to companies, executives and supervisors engaged actively in the industry of excavation.

COPYRIGHT 1939 BY THE EXCAVATING ENGINEER PUBLISHING COMPANY

3 OUTSTANDING JACKHAMERS

For Use Where Speed, Service and Economy Count

• Low cost drilling demands Jackhamers which combine fast drilling speed with a minimum of upkeep over long periods of time.

Because "JA" Jackhamers have these features, they are the most popular and widely used of all rock drills.

A thorough test on your job will convince you that these machines drill faster, and cost less to operate.

If you are interested in this *low cost drilling* try "JA" Jackhamers — there is a machine for every practical purpose. Just call on our local rock drill man. He will be glad to help you.

Other I-R products include portable and stationary compressors, drifter drills, stopers, drill steel sharpeners, Jackbits, Diesel engines, hoists, pneumatic tools, pumps, etc.

The

JA-35

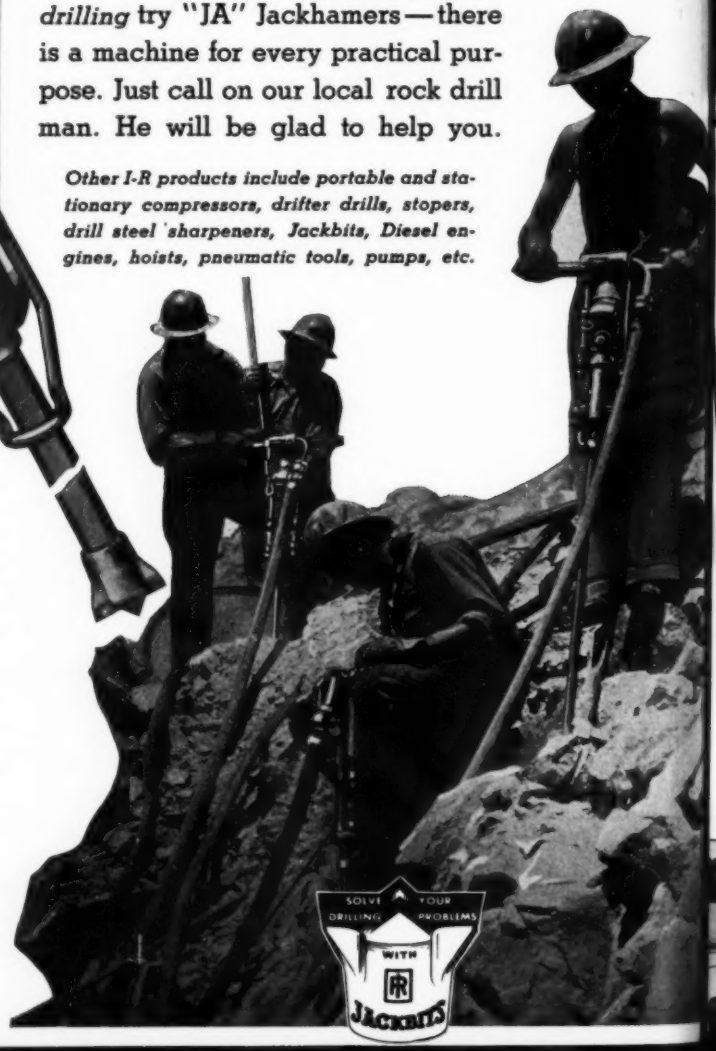
THE *Newest* ADDITION TO THE FAMOUS JACKHAMER FAMILY

JA-35 This new drill is the latest addition to the already famous JA family. While light in weight (less than 35 lbs.) its design closely follows the heavier JA-45 and JA-55 models. It is light enough for cutting hitches; trimming, taking up bottom, placing trolley hangers, popholing, and still powerful enough for a great deal of general work. It makes an ideal drilling combination with the Model 55 portable air compressor.

JA-45 The JA-45 is a light-weight, fast-drilling machine especially suited for general excavation and for contract or quarry work. It is one of the most popular and most widely used Jackhamers in use today. Its low air consumption makes it especially desirable for use with portable compressors and wherever air is at a premium. (Weight 45 pounds.)

JA-55 This model is a hard-hitting, fast-drilling tool designed for harder rock and deeper holes. It is popular for mine, quarry, and heavy contract work. A particular application is for shaft sinking and general mine work in hard rock. When equipped with a Jackhamer mounting, it can be used on a column or bar for light drifting or stoping work. (Weight 55 pounds.)

(New York State Board of Standards and Appeals Approval No. 2342)



Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City
Knoxville
Los Angeles
Newark
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake C
San Francis
Scranton
Seattle
St. Louis
Tulsa
Washington

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

729-5

INTERNATIONAL Power...
Engineered for *Plus* Performance

International TracTracTors have a great reputation for their fast, flexible operation unde tough conditions. This is the Model TD-40 Diesel doing its stuff on an earth-moving jo

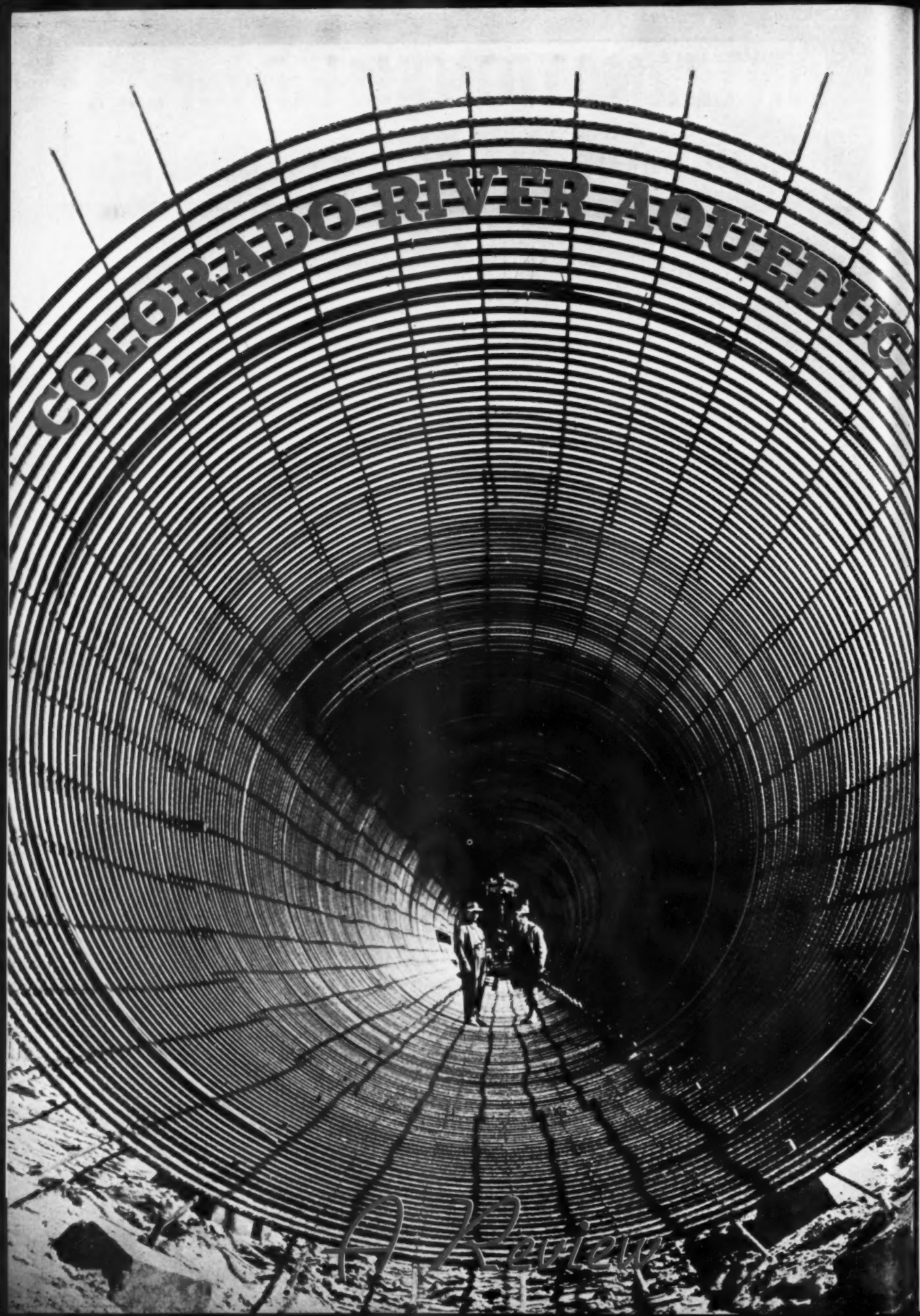
REPLACEABLE CYLINDERS are one of the many money-saving features engineered into International Industrial Tractors and Power Units. Cylinders may be removed and replaced with new cylinders of the same size. These new cylinders, with new pistons, fully renew the original engine compression and efficiency. This feature saves International owners the cost of expensive reboring operations.

• There are many sound and practical reasons back of the wid preference for International Industrial Power. When you buy Inter national you buy low-cost maintenance, long life, and performanc and economy that produce profit on the job . . . the result of th skilled engineering that goes into every detail of Internationa Harvester *quality* products. There are TracTracTors (crawlers) an wheel tractors for gasoline and Diesel operation, and 11 models o power units, gasoline, Diesel, and gas, ranging up to 110 max. h.p. in the International line. Check into these tractors and engine and see for yourself how they fit into your operations. The nearb International industrial power dealer or Company-owned branc will demonstrate the efficiency and economy of International Powe any time you say.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
180 North Michigan Avenue — Chicago, Illinois

• *International Power Units are readily adapted to a wide variety of work. This is a Model PD-80 Diesel operating a suction dredge, producing 100 yards of sand and gravel a day.*

INTERNATIONAL INDUSTRIAL POWER


COLORADO RIVER AQUEDUCT

A $200,000,000 aqueduct that will lift water 1,617 feet above the Colorado River and carry it over 400 miles of hills and desert wastes through tunnels, conduits and canals to a thirsty Southern California.

BY JOHN R. MARCY

AT RARE periods down through the ages men have built great and enduring structures — the pyramids, the Great Wall of China, the Roman roads—at which future generations have marvelled. Today we are living in such a period, greater than any preceding one because of our technological advantages. With such works on every hand we are likely to take these accomplishments for granted. Actually they dwarf the past. There has never before been anything like them, and there is little doubt that future generations will look upon the men who built them as a race of titans. One of the greatest of these is the Colorado River Aqueduct, the scope and size of which is almost beyond comprehension.

On January 7, 1939, the first water flowed into the aqueduct when the Intake pumping plant was placed in operation. With all major features finished and the whole 93% complete, the culmination of fifteen years of engineering and construction work is now only a matter of months. It is with the design of giving some idea of the whole picture, together with the essential details of construction, that this review is presented.

Purpose of the Aqueduct

The area surrounding Los Angeles, known as the south coastal basin, consists of 2,200 square miles of habitable lands. Naturally semi-arid, the local water resources are inadequate for the needs of the area. Since no long rivers flow into the region it is necessary to bring water in by artificial conduit. In 1913 an aqueduct 233 miles long was constructed from the Owens Valley in the High Sierras, the nearest point of high rainfall. The water so brought in was for use only in Los Angeles, and with the growth of the city the time when it would not be adequate was not far off. With the rest of the area yearly using more than the annual yield from its resources, it was imperative that some provision for future needs should be made. With no other important source unappropriated, the Colorado River was the nearest available source.

In 1928 an organization known as The Metropolitan Water District of Southern California was formed for the development of this water supply. 13 cities comprised the district, and a board of directors, made up of at least one member from each city was appointed and empowered with authority to sell water and levy taxes to carry on the work. These member cities are Anaheim, Beverly Hills, Burbank, Compton, Fullerton, Glendale, Long Beach, Los Angeles, Pasadena, San Marino, Santa Ana, Santa Monica, and Torrance. Provision was made to permit other areas to join the district as desired.

Large-scale Surveys Made

Since the topography of the country did not indicate a single best possible route for the aqueduct, large-scale surveys were made, and all possible routes studied. A major divide separates Los Angeles from the Colorado River, but gravity routes were possible for diversion from high dams far up the river. These were abandoned either because of the prohibitive costs or impossible construction conditions. The Parker route which was finally selected was considered the safest to build and maintain, for while some of the routes from diversion points farther down the river were somewhat lower in first cost, they would have been much more expensive and less satisfactory to operate.

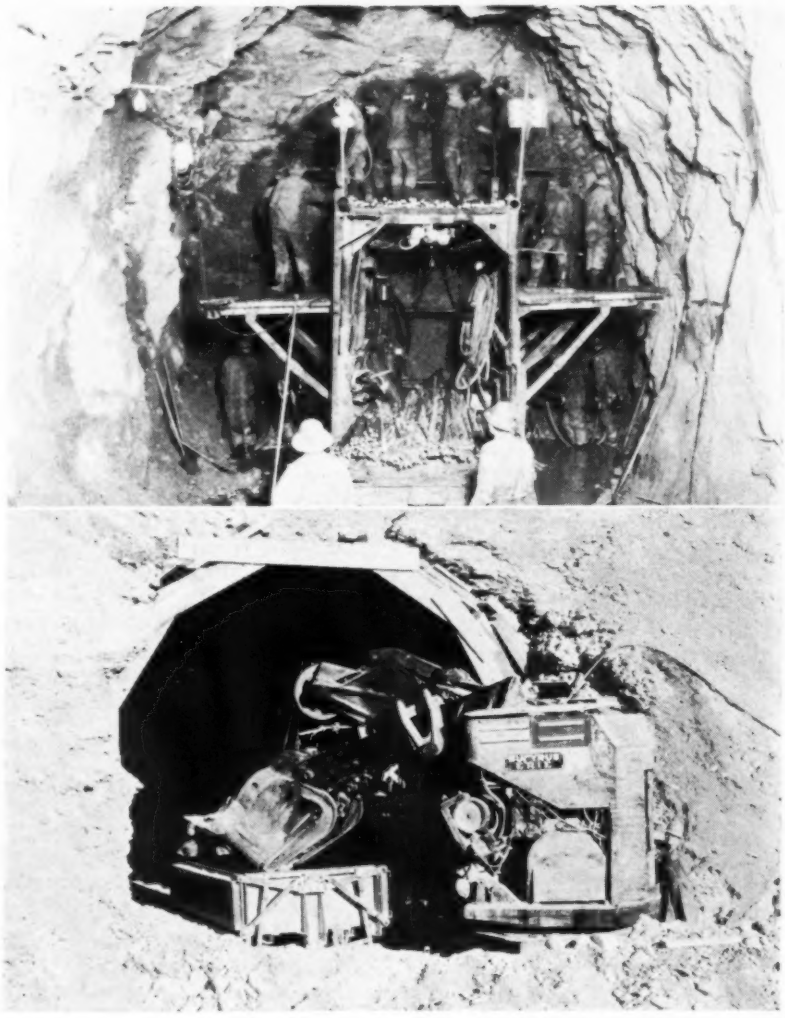
Determination of Design

Three major factors controlled the design of the aqueduct. These were, first, the fact that a lift of 1,617 feet was necessary to raise the water over the divide. As the area slopes gradually upward from the river westward about 135 miles, a series of five separate pumping plants with lifts varying from 144 to 441 feet were required.

Second, a capacity capable of

• Against a background of heavily eroded hills lies construction camp headquarters. Buildings are typical of those erected at the various contractors' camps.

• Top: Full-face tunnel excavating with a battery of automatic drills mounted on a double-decked drill jumbo. Bottom: Tunnel shovels of this type played an important part in mucking operations.



taking care of a billion gallons of water a day was necessary to divert the 1,100,000 acre feet per year filed upon by the District, and while the full capacity will not be needed at first it was uneconomical to construct the main line at partial capacity. Pumping plants and distribution lines could be built economically in separate units, and portions of these not needed now have been left for future expansion.

Third, the first costs and operating costs determined the size of the conduit. The steeper the slope, the smaller the conduit which may be used because of the faster flow, but here a steep elevation could only be secured at the expense of pumping. High ground had to be crossed, but the cost of pumping over a mountain was in the long run more expensive than tunneling through it. Hence, a combination of lift and tunnels with the aim of a minimum cost of water to the consumer was incorporated in the design.

Description of Features

The main line of the aqueduct extends from the Colorado River at Parker to Cajalco Reservoir, a total length of 241.6 miles, largely across barren, desert waste. It is made up of 92.1 miles of tunnel, 54.4 miles of cut-and-cover conduit, 62.8 miles of open concrete-lined canal, 28.7 miles of inverted siphon, 1.2 miles of pumping delivery lines, 1.1 miles of unlined canal into Cajalco Reservoir, and 1.3 miles of passage through reservoirs.

Water is diverted into the aqueduct from Parker Dam, 155 miles downstream from Boulder Dam. This dam will raise the river level 72 feet, providing a 717,000 acre feet storage basin for regulating and clarifying the water. It is a concrete arch type, with five 50 by 50 foot roller bearing gates to provide for flood control. Both dam and reservoir were constructed by the Bureau of Reclamation with funds provided by the District, and will be owned and operated by the government. One-half of the power rights is retained by the government, the remaining half belonging to the District.

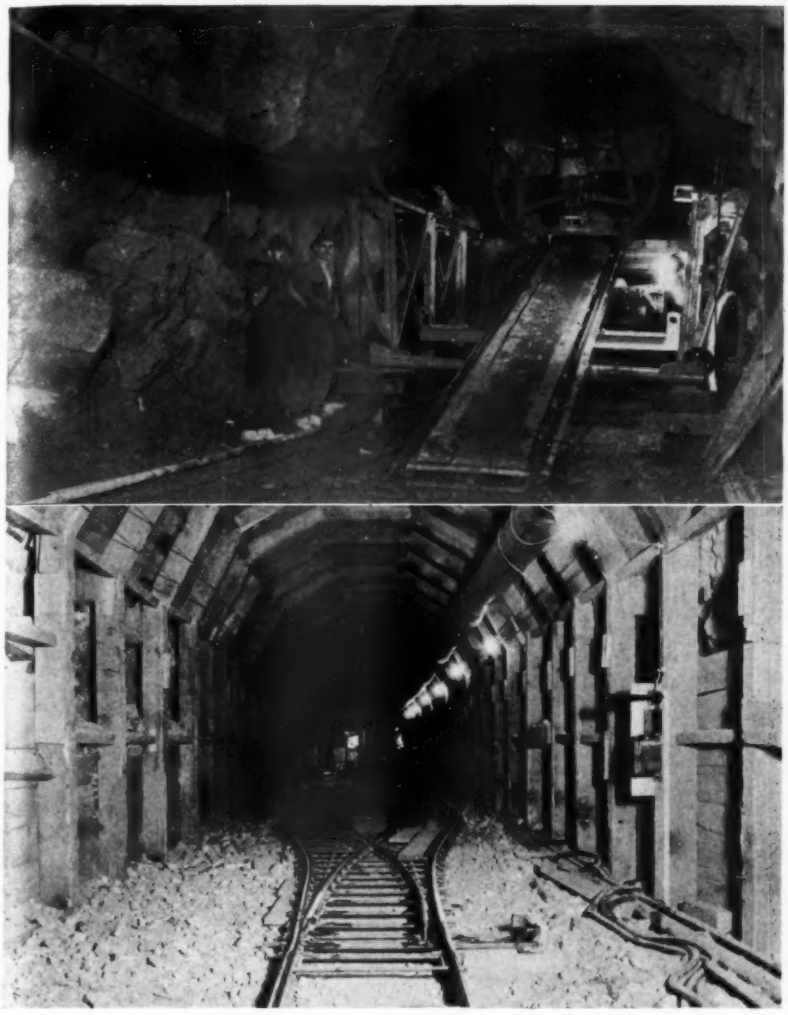
Actual diversion will be made by a pumping plant two miles upstream from the dam. It lifts the water 291 feet to Gene Wash Reservoir, which has a capacity of 6,300 acre feet. From here the water is lifted 303 feet by a second pumping plant and delivered through tunnels and siphon to Copper Basin Reservoir (24,200 acre feet) from where it flows westward about 125 miles to Hayfield Reservoir. In this stretch two other pumping plants, at Iron Mountain and Eagle Mountain, lift the water 144 feet and 438 feet respectively. The final lift, at Hayfield Reservoir, elevates it 441 feet, and from this point it flows by gravity to Cajalco Reservoir, which provides a storage capacity of 100,000 acre feet.

Types of Conduit

Four types of conduit are used on the main aqueduct, open lined canal, cut-and-cover conduit, tunnels, and inverted siphon.

An open lined canal is the cheapest type of conduit to construct and requires less fall for operation. It was therefore used wherever practicable. It is, however, more subject to flood damage, so that it was constructed only where simple cross-drainage problems occurred. It is well set down into the ground and protected by embankments and a system of training ditches, and is used only east of the Hayfield Reservoir, so that in case of damage, pumping can continue from that storage basin.

Cut and cover conduit is used across desert areas where canal is not permissible, and for surface lines west of Hayfield which are



• Top: Showing the "grasshopper" with runway lowered. Bottom: California Switch. Note the single line of main track over which the switch is superimposed.

not under pressure. It was built in an open trench and then backfilled to a minimum depth of three feet over the crown. The normal section will withstand weight of fill up to 30 feet on firm foundation. For yielding foundations and for highway and railway crossings additional concrete and steel reinforcing were used. The normal section was not reinforced. Construction joints with steel-tongue water stops were provided at 35 foot intervals.

Because of their expense, tunnels were used only where other types of construction were impractical. About 60% of the 92.1 miles pierced mountains which obstructed the route. The rest is required where the topography is too rugged to permit a surface line. Unsupported construction is used where the rock is good. Where broken or unstable rock prevails, timber or steel supports are used. Where necessary, wooden roof boards 2 to 4 inches thick are used on the outside of the beams. The use of wood lagging on steel I-beam ribs was originated here and proved to be very economical and efficient.

Inverted Siphons Replace Roman Method

The Romans built beautiful but costly arches to support their aqueducts across depressions because their conduit was not strong enough to withstand the pressure resulting from a steep incline. Today the inverted siphon is used. It is constructed of reinforced concrete and is of three types, the double circular barreled, used whenever the length exceeds 400 feet or where the head exceeds 25 feet; the single circular barreled, used for short lengths and where the head is low; and the rectangular 3-compartment barreled, used to connect open canal sections. The double barreled siphons are from 11 feet 5 inches in diameter to 12 feet 9 inches, the single barreled 16 feet, and the rectangular siphons consist of three 9 feet 9 inch square compartments.

Wasteway structures controlled by radial gates and capable of diverting the whole aqueduct flow into natural drainage channels are provided at intervals. Overflow spillways at pumping plants, sand traps and settling basins and highway and railroad crossings are provided for.

Five Pumping Plants

The five pumping plants are equipped with vertical shaft, single stage, single suction centrifugal pumps, directly connected to synchronous motors. Pumps will be located below the lowest inlet water level so that they will always be primed with no danger of flooding. The nine units of each plant are being installed in groups of three, each group being connected to a steel delivery pipe equipped with a shut-off gate so that any unit may be shut down for inspection and maintenance. District transmission lines from Boulder Dam bring power to the pump motors and will ultimately carry 280,000 kw, enough to light a city of over a million people.

The main aqueduct ends at Cajalco, about 60 miles east of Los Angeles. From here the water will flow by gravity in pressure lines and tunnels. The delivery system will consist of a "high line" from which smaller delivery lines will lead off to the member cities. The high line ends at Eagle Rock and consists of 36 miles of precast reinforced concrete pipe and 10.3 miles of steel pipe lines varying from 9 feet 8 inches to 12 feet 8 inches in diameter, and 16.2 miles of circular tunnels which except for the 14-foot outlet tunnel at Cajalco are 10 feet in diameter.

Some idea of the size of the

project is revealed by the quantities of materials used. 5,000,000 cubic yards of concrete, 7,700,000 barrels of cement, 266,000 tons of steel, 41,000,000 yards of excavation, are a few of the figures.

A bond issue of $220,000,000 was voted by the District on September 29, 1931, and these bonds are sold to the Reconstruction Finance Corporation. The project will be self-liquidating from revenues derived from the sale of water. A tentative charge of $8 per acre foot plus the cost of softening has been established as an adequate rate. The initial construction will not only be accomplished within the amount of estimate, but at about $20,000,000 less than originally figured.

An executive staff was appointed by the Board of Directors with administration offices located in Los Angeles. Its personnel is as follows: F. E. Weymouth, General Manager and Chief Engineer; J. L. Burkholder, Assistant General Manager; Julian Hinds, Assistant Chief Engineer; J. M. Gaylord, Chief Electrical Engineer; James Munn, General Superintendent of Construction; L. V. Branch, Senior Engineer; Don J. Kinsey, Assistant to General Manager. Division Engineers were W. E. Whittier, John Stearns, R. C. Booth, J. B. Bond, Robert N. Allen, O. J. Schieber, R. B. Diemer and B. C. Leadbetter.

Field headquarters were located at Banning, California, in charge of the Assistant General Manager, who had charge of all construction and engineering operations on the main aqueduct. Division engineers in charge of field work reported here. A concrete and cement testing laboratory for experimental and standardizing work was also located at Banning.

Gave Employment to 35,000

Approximately 35,000 persons have been given employment directly on aqueduct construction work, the maximum number on the payrolls at any one time being about 10,000. Under District ruling, employees were required to be residents of the district for a year previous to employment and to pass a medical examination. Not more than one member of a family was employed, and preference was given to ex-service men with dependents.

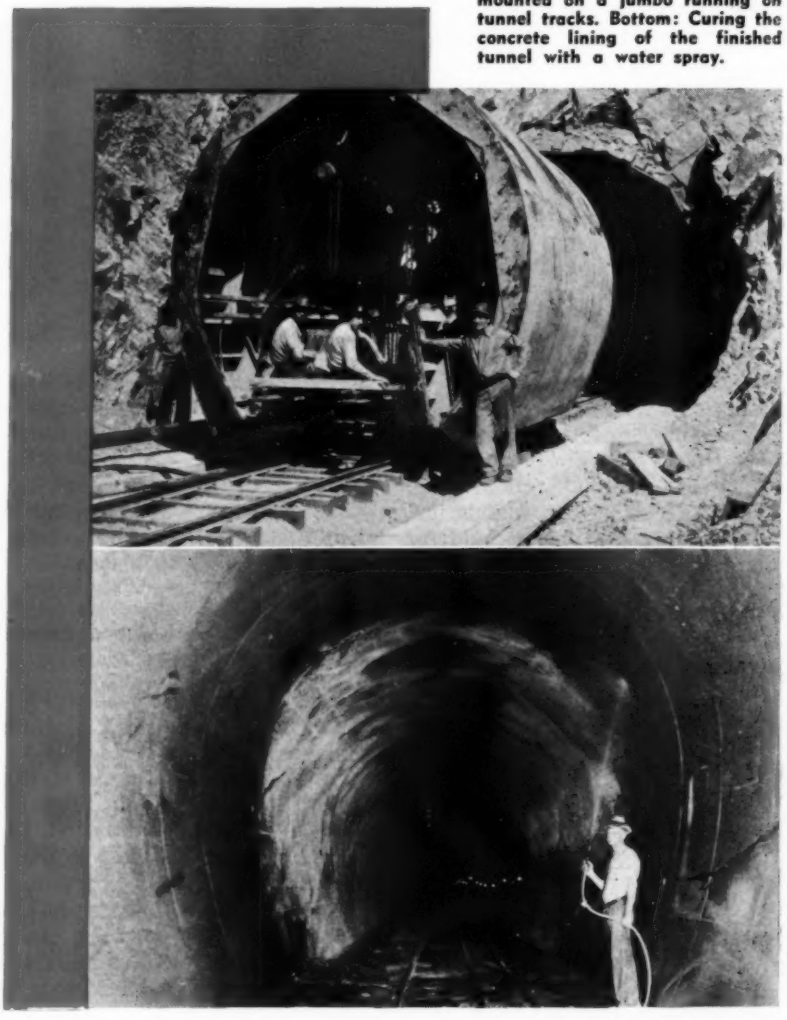
To minimize the accident hazard, a safety program was worked out and rigidly followed throughout the course of construction. Safety rules, educational meetings, contests, mechanical safety devices, sanitary provisions, all resulted in a sickness and accident rate far below the average for this type of work. First aid stations and well-equipped hospitals were provided where prompt attention could be given to all classes of injuries. Safety Engineer T. W. Osgood was in charge of this program.

Actual work of construction was begun near the end of 1932 upon the completion of arrangements for financing. Generally, those features requiring the longest time to complete were started first. Work was divided into many units, and work proceeded independently on each unit under contract or by District force account, operations being carried on simultaneously all along the line.

Contractors on the Job

The contracting firms represented were as follows: TUNNELS—Walsh Construction Co., Winston Brothers Co., Utah Construction Co., Broderick and Gordon, L. E. Dixon and Bent Brothers, Hunkin-Conkey Construction Co., Shofner and Gordon, J. F. Shea Company, Inc., Morrison-Knudsen Company, West Construction Company, Hamilton and Gleason Company, and Dravo Contracting Company.

CANALS, CONDUITS AND SIPHONS — Aqueduct Construction Company, Barrett and Hilp



• Top: Collapsible steel form used in placing concrete tunnel lining mounted on a jumbo running on tunnel tracks. Bottom: Curing the concrete lining of the finished tunnel with a water spray.

and Macco Corporation, Jahn and Bressi Construction Company, Wood and Bevanda, Utah Construction Co., Three Companies, Inc., Thompson-Starrett Co., Inc., United Concrete Pipe Corp., J. F. Shea Co., Inc., Morrison-Knudsen Co., Griffith Co.

DISTRIBUTION TUNNELS—West Construction Co., Griffith Co., L. E. Dixon, Bent Bros. and Johnson, J. F. Shea Co., Inc.

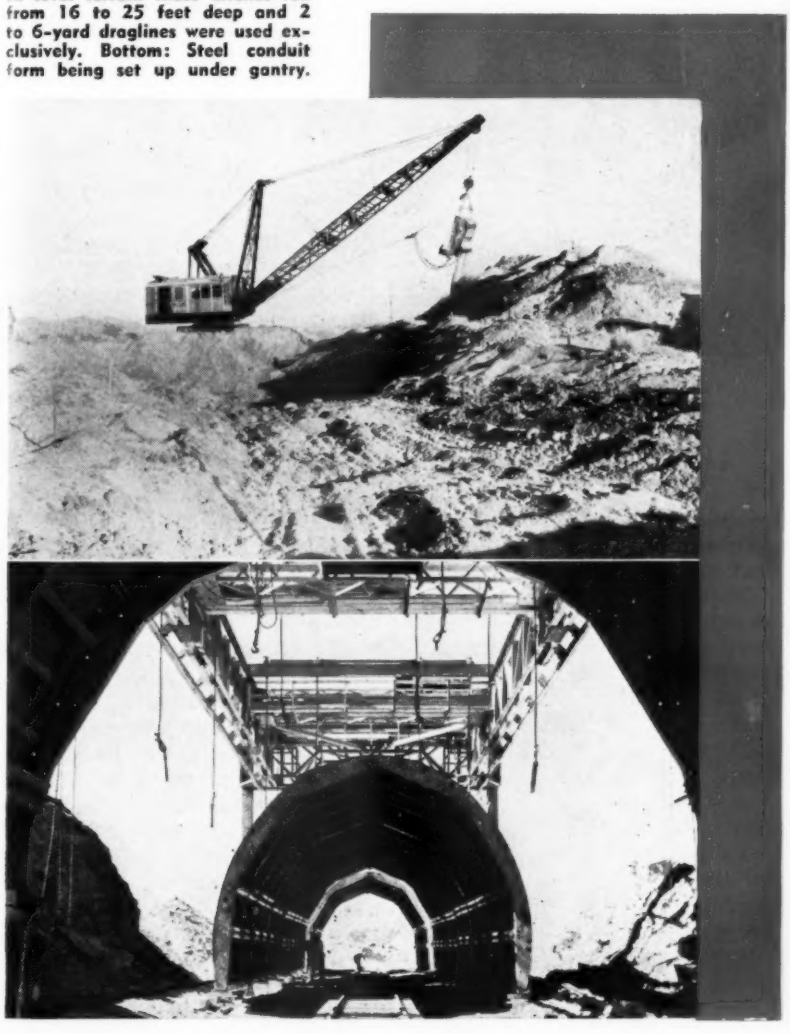
DISTRIBUTION PIPE LINES—American Concrete and Steel Pipe Co., Western Pipe and Steel Co., J. F. Shea Co., Inc., United Concrete Pipe Corp., Basich Brothers.

Preliminary Construction Necessary

The eastern part of the aqueduct runs through a desert region in which there is no water nor ordinary living facilities. Before construction could begin, a great deal of preliminary work was necessary. To this end, 153 miles of surfaced highways, 477 miles of power lines, 1,273 circuit miles of telephone line, and 180 miles of water supply lines with wells and pumping plants, were constructed.

Trunk roads, following the main line of the aqueduct, were built 20 feet wide and were surfaced with a three-inch top layer of oil treated material laid on a base of natural material. On the eastern end some bridges were built across dry washes. These roads have stood up well under the heavy hauling to which they were subjected. Most of the branch roads were graded and oiled, although a few, where the desert floor was chiefly gravel, were merely cleared and graded.

• **Top: Excavating conduit trench. In level terrain these ditches ran from 16 to 25 feet deep and 2 to 6-yard draglines were used exclusively. Bottom: Steel conduit form being set up under gantry.**



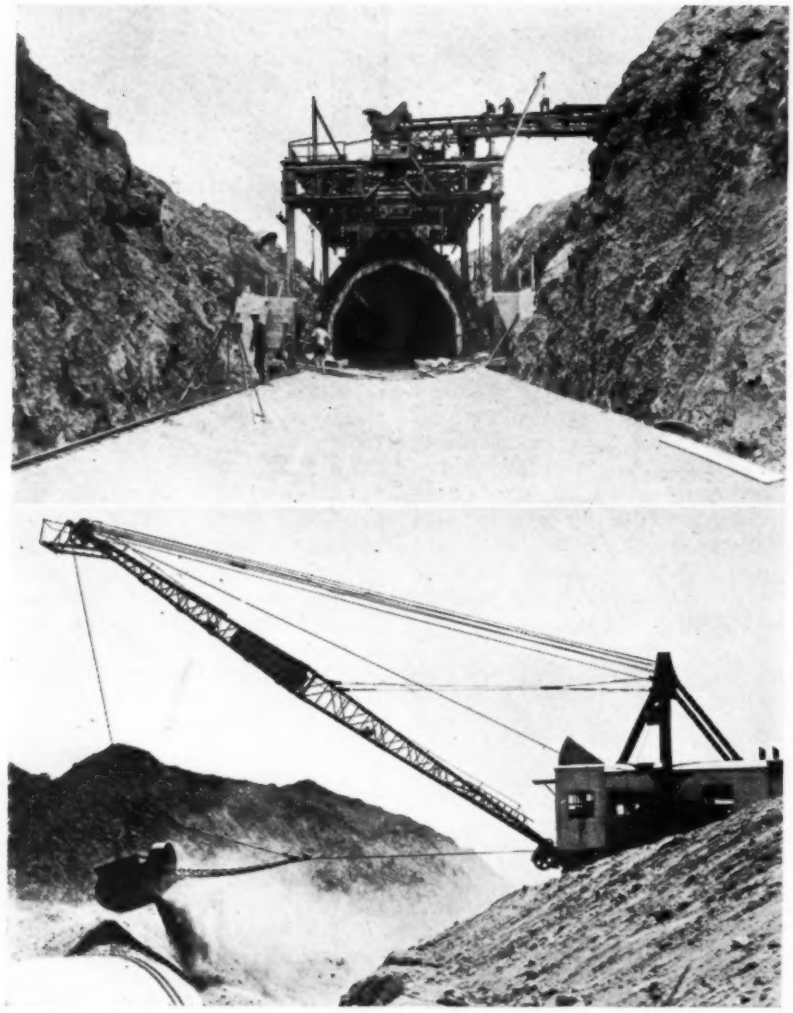
The water system extended over the entire 200 miles of the aqueduct where no local facilities were available. Except for the wells on the banks of the Colorado River, water was drawn from underground desert basins. Aeration and chlorination were necessary at some places to remove CO_2 and prevent growth of corrosion producing organisms. Fourteen wells, a 5 to 8-inch steel pipe line with booster pumps and 35 tanks and reservoirs, provided a source at all points from which the various construction camps tapped supplies for camp and construction purposes. Well pumps ranged from 100 to 750 g.p.m., booster pumps from 55 to 300 g.p.m. Storage tanks were provided at each well and at each diversion point, and 6 — 300,000 gallon general storage tanks were also installed. Contractors were charged from 20 to 40 cents per thousand gallons.

No adequate source of electric power being available along the line and the development of its own plants being uneconomical, the District purchased power from private Southern California companies which was delivered to Colton, near the western end of the main line. The system was designed to carry a peak load of 18,000 kw, and the supply was controlled from sub-stations 24 to 52 miles apart, each provided with houses, water supply, and other living facilities for the operators.

Telephone System Installed

A telephone system for the use of field contractors was installed which consisted of 5 exchanges with inter-connecting trunk lines and local distribution circuits. Later, 137 miles were added connecting Boulder Dam power house with the aqueduct pumping plants, making a total 1,420 miles. All main line circuits will become permanent operating facilities.

Housing had to be provided through the desert area, and roomy dormitories, mess halls, and offices were constructed on the various schedules. Most of these structures were of wood, sheathed inside, and equipped with cooling systems. Food was delivered in refrigerated trucks, and refrigeration was provided at the camps. Men were charged $1.15 per day for meals and 25 cents for rooms,



• Top: Gantry in action pouring concrete on conduit form. Note jumbo for handling inner form just inside. Bottom: Backfilling the finished conduit to depths of 3 to 30 feet over crown.

however, living in camps was not compulsory.

Over 92 Miles of Tunnels

Construction of the 92.1 miles of tunnels went forward with a speed which broke many records. All tunnels on the main line east of San Jacinto were dry, and in these no serious difficulties were encountered. About 63% of the length had to be supported, but for the most part the construction of these dry tunnels proved less difficult than was expected. West of San Jacinto some water flow developed but did not cause serious handicap. In San Jacinto, though, excessive flows under high pressure required the installation of expensive pumping systems to remove the water and added many complications which greatly impeded progress. The construction of this difficult tunnel is an interesting story which, because of space, must be summarized here in the statement that all problems were solved.

Notable improvements in equipment and methods, many of which were developed on the aqueduct, contributed largely to speed and economy in tunnel construction, particularly in the case of mucking machines and drilling equipment. With modern mucking devices it was possible to load a ten-foot round of muck from an 18-foot tunnel in about two hours, instead of the 8 hours formerly required. Muckers were chiefly of the conveyor-loader and the underground shovel types, both of which proved efficient.

In drilling, the use of heavier machines, automatic power feeds, independent drill rotation, and other refinements greatly decreased drilling time. Loss of time in setting up drilling scaffolds was eliminated and the employment of more drills and men made possible by the use of batteries of 5 to 11 drills mounted on double-deck carriages running on tracks, which drilled from 25 to 80 holes. The whole assembly could be quickly moved away from the face before firing the rounds and moved back again afterward.

Blasting was done with 40 to 60% gelatin powder, of which an average of 3.2 pounds per cu. yard of rock was used. Some rock took as much as 7 pounds per yard. The powder was detonated electrically from a 440-volt circuit used exclusively for this purpose.

Equipment improvements also made possible full-face excavation, so that drilling and mucking could be performed separately, thus doing away with the laborious setups and frequent interruptions caused by the old partial face method where drilling and mucking went on together.

Fast Car Handling

To keep pace with the speedy modern mucking equipment, improved car handling devices were necessary if the muckers were not to stand idle much of the time. The problem was to replace a loaded car at the mucker with an empty one as quickly as possible, and to do this several methods were employed. The movable trolley crane, or "cherry picker," operated on a beam set across the tunnel and lifted the empty to one side while the loaded one was withdrawn, and then returned it to the track ready to be pushed up to the mucker. The gantry crane, operated by electricity, lifted the empty so that the loaded car could pass beneath. The underground shovels were equipped with jib cranes on the back of the frame for this purpose. Another device was a steel truss bridge called a "grasshopper," the ends of which could be raised or lowered, and over which a track was built. Empties were stored on top of the structure and fed to the mucker as the loaded cars were pulled out below. The California

(Continued on page 282)

PUSHING 'EM OVER
WITH A BULLGRADER

Wayne H. Kirby, Missouri contractor, removes 23,000 trees in 12 days on a 160 acre farm clearing job.

By KENNETH FORCE

IN ABOUT a fifth of the time and with about half the expense it would require to do the same work by cable pulling, Wayne H. Kirby, contractor at Liberty, Missouri, used a Bullgrader to clear trees and brush from the slopes of the Hoefer farm one and one-half miles northeast of Mayview, Missouri.

Except for demonstrations this is the first use of the Bullgrader for this sort of operation in Western Missouri. It is Mr. Kirby's prediction that it will become the modern method of clearing land of trees and stumps. "And why shouldn't it?" is a natural question after an analysis of Mr. Kirby's tree clearance experience.

Equipment consists of a Bucyrus-Erie Bullgrader mounted on an International TD40 TracTractor. Mr. Kirby purchased the Bullgrader just before he started fulfilling the Hoefer contract.

Land to be Farmed June 1

While there is no time limit specified, the contract called for clearing the land so that it would be completely ready for the plow and corn planter before June 1. This meant pulling the trees so that root and trunk were free for burning, and then leveling the holes left by the uprooted trees.

The 160 acres contained over 5,000 elms and oaks that were 6 inches or more in diameter (a good many were two feet thick), 3,000 apple trees, and 15,000 elm and other trees that were under 6 inches in diameter. In addition there was a lot of brush which, running to a height of five and six feet, consisted of very small trees, Blackberry brambles, etc. The apple trees were planted 50

1

2

3

4

5

6

● Starting on Page 257: (1) Bullgrader pushing bole of tree with shoulder of grader blade. (2) Hitting the tree with the full blade. (3) Bearing down on a big one. (4) The tree breaks loose and starts going over. (5) Going down! (6) All the way down and ready to be dug out and pushed into the central clearing preparatory to burning.

years ago by the Stark Nurseries at Louisiana, Missouri, now operated by Governor Lloyd C. Stark and his family.

With a Bullgrader, clearing the trees became an extremely efficient operation. The grader blade was set at as much of an angle as possible. On good sized trees the equipment came into the bole of the tree about three feet above ground and at the outer and forward end of the blade. The tractor forced the blade to bear across the tree, the angle permitting a certain "give."

Pushing Over the Tough Ones

If the tree didn't go over on the first push, the operator, Cecil Jameson, proceeded to give it what might be called the "tight fist." As he went into the bole, the hydraulic pump was set to raise the blade. When it became apparent that the tree wasn't going over, he released the power from the track, and let the motor pick up; at the same time the easing of the blade's pressure on the tree permitted the blade to rise slightly, and the equipment bucked into the tree again at a somewhat more oblique angle. This was done several times in rapid succession. It required a really tough tree to withstand this treatment.

If the tree looked as though it would break up fairly easily—and this was especially true of the apple trees, Jameson used the outer shoulder of the grader blade, which is reinforced and replaceable. In most cases this pushed over the whole tree. In some instances it took away part of the bole, with another "go" necessary to carry away the remainder.

After the tree was pushed over Jameson backed up, ran the blade into the ground a foot or two, and cleaned out what remained of the roots. Both the tree and the roots were pushed several feet clear of the root hole in order to simplify subsequent "mopping up" operations.

On really tough ones, the operator used the Bullgrader to excavate a ditch along one side of the tree, and then applied the pushing power of the equipment

against the bole on the side opposite the ditch.

Two "Goes" Required for Most

On medium sized trees it usually required only two "goes," a thrust at the bole and the rooting operation, to complete the job. Even some of the larger elms two feet in diameter were cleared away in these two movements. Some of the larger ones required three or four. On smaller trees the operator put the blade in, starting about three feet from the bole, and let it down to a maximum of about a foot under ground at the point where the bole met the ground. This carried away tree and roots in one operation. The small roots rolled upon the moldboard, the blade pulled tree and taproot out, came up on the other side, and the job was done.

The apple trees originally were grafted on oak, so that the stumps and roots were oak, not apple. Ninety-nine per cent of the apple trees were partially dead, or eaten by borers, and some were partially decayed; but the roots of practically all of them were still green. According to Mr. Kirby, it would have been impossible to pull the apple trees by cable because they would have broken off and made it necessary to dig out the roots by hand.

The brush was cut off at the top of the ground, with the blade of the grader set at level. This operation was performed as the equipment leveled up the holes.

Trees were piled and burned. When the dirt dried out around the roots, it was knocked off with the grader and, along with the dry brush, the roots were also burned.

Clearing a Swathe

Jameson, the operator, worked out the thickest growth areas by first clearing a swathe across the center, and then working up one side of the swathe and down the other, always pushing trees in toward the cleared space.

It required 12 working days of 10 hours each to complete the contract except for the mopping up operation. Mr. Kirby timed the operator on a group of 20 trees which were representative of the

● Top: Close-up view of grader blade shoulder "coming into" a tree. Bottom: Breaking the remaining roots, the Bullgrader pushes a big one into the clearing.

trees in the entire acreage, and it required just 25 minutes, or slightly over one minute per tree. Using a cable would have taken five times as long. The difficulty of the cable method on the apple trees would have been almost insurmountable, according to Mr. Kirby.

Throttle of the tractor was left at full because the distance between trees was so short. This increased the speed of the work. However, the tractor, which is 28 months old and had its first set of sleeves and pistons installed a year ago, used 30 gallons of Diesel fuel a day, due largely to the fact that the throttle was kept wide open all the time. About a gallon of oil in a week of seven days was used.

Beats Cable Pulling Method

The contract was for $2,600. It is estimated that the cost of cable pulling would have run twice as much as the present method, the difference in money going into labor. There would have been an immeasurable difference in trouble.

The present equipment lost only four days because of heavy rain. As a matter of fact, it worked part of the time in the rain, and it was not difficult to use immediately after rain.

Just before going to Mayview on the Hoefer job, Mr. Kirby

(Continued on page 298)

Moving 2,000,000 Yards
ON THE ALBERT CANAL

Construction Etude and Ouvraison Company completes a 5¼ mile section of Europe's largest canal.

UPON ITS completion, the Albert Canal will be the largest canal ever built in Europe. Started in 1930, this immense project named in honor of the late King Albert, has passed another phase of its ultimate completion.

The Albert Canal is designed to shorten the water route between Liege and Antwerp from 98 to 78 miles, a saving of 20 miles. Reducing the number of locks and straightening and widening the old canal will enable traffic to move at a greater speed. Barges that have been limited to 450 tons burden by the old canal will be increased to 2,000 tons.

The new canal will aid in the development of coal mines in the Limbourg district and will aid in reclaiming thousands of acres of agricultural land through the irrigation of the Campine district. It has also been routed to form a link in the system of Belgium's national defense.

Fulfilling a $1,500,000 Contract

The construction of this 5¼ mile section of the Albert Canal in Belgium was handled by Construction Etude and Ouvraison Company in fulfillment of a major part of its $1,500,000 contract calling for a revision of the old canal. Improvement of the old canal between the bridge of Wandre and the old lock at Haccourt called for the handling of the following quantities:

Earth filling for the new dykes	1,548,000 cu. yd.
Lining side and bottom of canal with mixture of clay and gravel	430,000 cu. yd.
Earth filling for the bridge approaches	770,000 cu. yd.
Excavation for new section	1,890,000 cu. yd.
Removal of turf	309,000 sq. ft.
Building of water wings	376,000 sq. ft.
Concrete	78,480 cu. yd.

Fulfillment of this contract necessitated a large and varied scale of operations by the Belgian company. The first requisite included all earth moving, cutting and filling as well as cleaning stream beds between the right side of the canal and their outlet to the river Maas.

Next came the building of right and left quai walls on the upper stream section and of embankments on the down stream left end section including their anchorage with earth dykes. The canal bed and walls were waterproofed with a lining mixture of clay and gravel.

Varied Construction Work

Construction work included the building of water wings, masonry supports for the new bridge at Wandre, including retaining walls for the inclined roadways connecting the bridge, also the supports of the road bridges at Vivegnis, Hermalle sous Argenteau, and Haccourt. A culvert was built along the new embankment on the left side of the down stream section and two more underneath the canal for drainage purposes. Water intakes for these culverts have also been built.

The construction of various roads for connecting the bridges crossing over the canal with existing roads and the building of various structures were further phases of the complex Albert Canal job.

A variety of equipment was assigned to the construction of this section of the Albert Canal. Playing the leading role was a Ruston-Bucyrus 52-B dragline with a 60-foot boom and a 2½-yard bucket. This dragline also had a 15-foot boom extension with a 1½-yard bucket. The same machine was

● Ruston-Bucyrus draglines played a major part in the digging of this section of the canal. Left to right: A 52-B builds a dyke; at work on the canal lining; and a 32-B working near the Wandre bridge.

used as a grabbing crane with a 1½-yard self-dumping grab.

Use Five ½-yard Draglines

The removal of the turf and the preparation of the ground for the fill of the dykes was carried out by five ½-yard Ruston No. 4 draglines loading into 6½-yard narrow gauge dump cars which in turn transported the material to the approaches of the bridges to be used as filling. This operation was handled by a crew of ten men spreading the material in layers of 20 to 30 inches. These layers were compacted by Caterpillar tractors equipped with sheepsfoot rollers.

The embankment construction and heavy excavation of the Albert Canal was performed by the Ruston-Bucyrus 52-B which, with its 75-foot boom, could stock pile direct. Material dug out by the 52-B was spread by Caterpillar tractors equipped with LaPlant Choate bulldozers. In handling the wet clay one Caterpillar was used to spread it and another, traveling at right angles to the axis of the canal, rolled and compressed the clay.

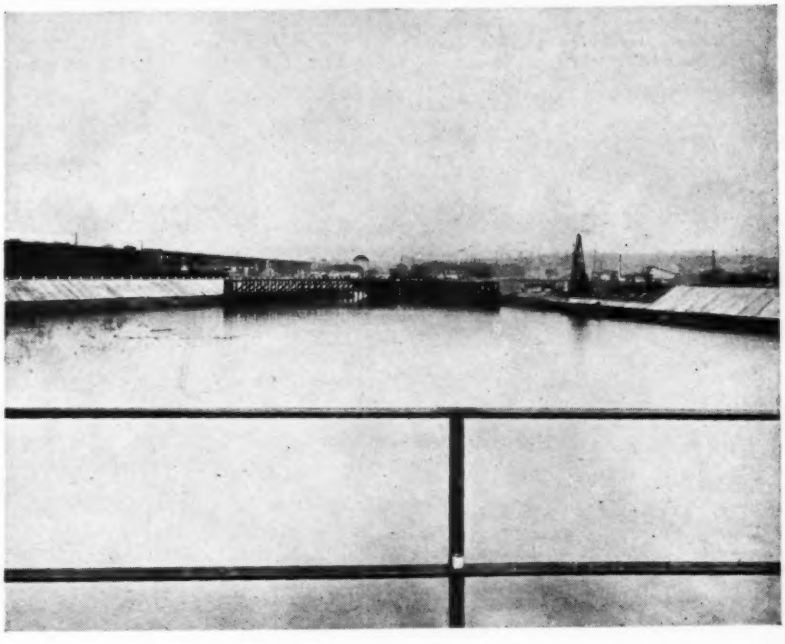
Material left from the excavation of the canal and not used for the dykes and embankments was temporarily stock-piled by ¾-yard Ruston-Bucyrus draglines. Upon completion of the cut the material, with a 40% addition of gravel, was rehandled by the ¾-yard draglines and spread by bulldozers. After it was mixed again by a Caterpillar equipped with a harrow the mixture of clay and gravel was compressed to a water proof lining about 20 inches thick.

General Dimensions

The first mile and a half of this 5¼ mile section of the Albert Canal was widened by cutting into the right bank. Beyond this point and for the remainder of the 5¼ mile section the majority of work was done on the left bank. The canal varies in width at the top of the dyke from 246 feet to 360 feet and on the floor from 144 feet to 263 feet. At the points where quai walls were constructed the width is reduced to 115 feet. The canal depth is 16 feet 6 inches.

Besides the general excavation work described, Construction Etude and Ouvraison Company was called upon to build a dam and protection lock at Monsin to maintain the level of the river Maas at 196 feet above sea level. Docks at Monsin and another lock at Vise were also built.

• A ⅜-yard Ruston-Bucyrus dragline working in Liege on the grounds of the 1939 International Exhibition.



• Top: The lock at Vise with the water at the old level. Bottom: Showing the new level of the water after canal reconstruction.

Field NOTES

Wrenches for Excavating Machinery

By W. F. Schaphorst

Several times I have seen the "kink" in print which shows how to make a wrench longer by "slipping a gas pipe over." It is a very simple procedure and it may look and sound good to some operators, but I don't believe in making a wrench longer in order to put nuts on tighter.

As you doubtless have observed, wrenches for small nuts are invariably short; for medium nuts, medium in length; and for large nuts, they are long. The manufacturers therefore seem to have some "system" in making wrench lengths, and they have. The pitch of the thread is considered, the cross-sectional area of the bolt at the bottom of the threads is considered, and the strength of the average man who does the tightening is also considered.

To make a wrench "twice as long" you therefore increase the tension on the bolts to twice the amount, the force of pull on the wrench being the same. By increasing wrench lengths, I have frequently actually "stretched" bolts until they broke in two, and have often stopped turning as soon as I felt the bolt begin to stretch. This is poor practice. Do not increase the wrench's length. The elastic limit of a bolt should never be reached.

If you feel like making a wrench longer for "unscrewing" a nut—all right. But don't make it longer for tightening; you may thereby cause expensive repairs to be made on your equipment or cause a serious accident.

● Tractors used by the George W. Condon Company at Imperial Dam, have a hole drilled through one track shoe on each side, which can be lined up with the inner track tension nut, as shown. A wrench with long shank is inserted through this hole and used to tighten up the nut without having to crawl under the machine.

Careful Study Reduces Conveyor Belting Costs

An intelligent, carefully studied use of conveyor belting in the handling of rock products can easily result in a marked cut in production costs and an increase in the speed of handling. But, in handling rock products, a quarry owner must have a type of belting that is capable of taking plenty of punishment without an interruption of service. He will find it profitable to study belting specifications as applied to his particular job, and then buy only the best for the money. This is the opinion of Ralph N. Boger, superintendent of the Annville Stone Company, Lebanon, Pa., after his experience with a new conveyor system installed at the Annville quarry in 1922.

The Annville Stone Company produces high calcium limestone, chiefly for the steel and cement plants. Forty men are employed in this quarry and plant and the quarry has been in operation since 1913. It is regarded as one of the most modern and best-equipped stone plants of its kind in the country.

The conveyor belt installation in 1922 required belting that would carry limestone varying in size from "one-man size" downward to the smallest sizes. It passes through a tunnel driven upward through the wall of the quarry at an angle of 23 degrees and is so located as to serve the crusher that is located in the center of the quarry floor. It carries the limestone from the primary crusher on the floor of the quarry to the surface where it is sized and loaded into railroad cars.

The original installation in 1922 required a conveyor belt 808 feet long by 36 inches wide of 36 ounce duck. It was a 9 by 7 step ply with a 3/16 inch top cover and a 1/32 inch bottom cover. The first installation rendered exceptionally fine service almost without interruption until 1928 when it was replaced with another belt that looked like any other. But a quarry superintendent, Mr. Boger will tell you, cannot buy a conveyor belt in rock service on looks or price.

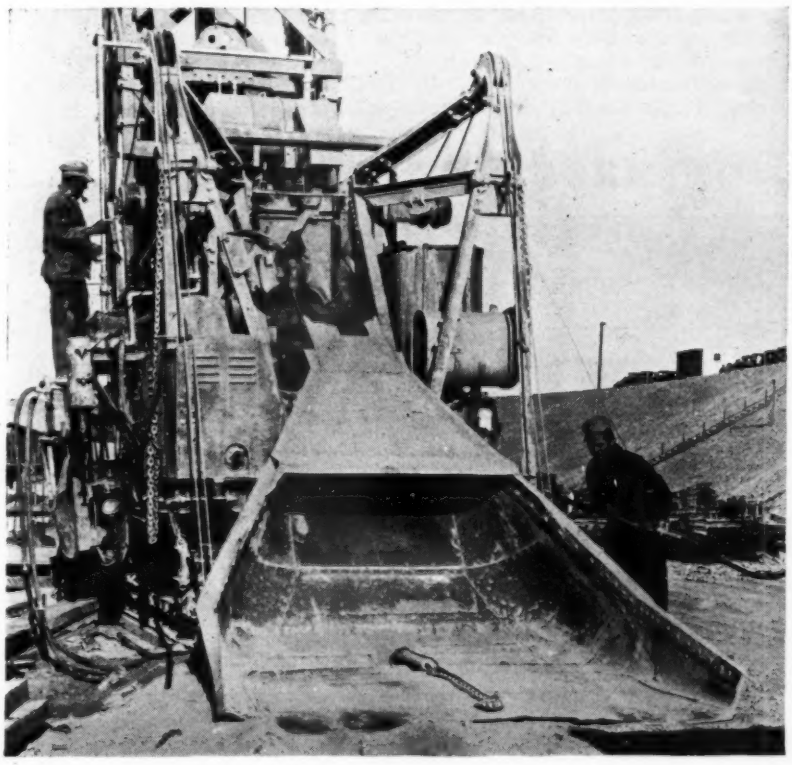
The original belt, from 1922 until the change-over in 1928, carried approximately 600,000 tons of limestone. Almost from the first there was trouble with the

● In paving a section of the Pueblo-Colorado Springs Highway, contractor Edward Selander of Fort Morgan, Colorado, found it economical to receive cement in bulk form and haul it to the mixing plant the same way. As this section was dry and somewhat windy, a metal cover was applied to the dump trucks to prevent cement from being wasted in transit.

replacement belt peeling. The stretch was excessive. By the time it had carried 300,000 tons, the belt was in such poor condition that many pieces had be be cut out and replaced with new belting. Even with the new pieces of belt installed at marked delay and expense, the replacement belt carried only 400,000 tons. In August, 1937, it was removed, proving too costly to keep in service.

The second replacement belt was bought to rigid specifications for the job it was required to do. Since August, 1937, it has carried 150,000 tons with no appreciable signs of wear. It was bought 34 inches wide rather than 36 inches as in the original specifications and this width has proved adequate. There has been no noticeable stretch and few cuts on the top cover. Its abrasive resistance has proven to be remarkable.

Mr. Boger believes there is a great dollar saving in buying a long-life, trouble-free belt. In his one bad belting experience there were two instances in which the old belt broke and slid down the tunnel, not only causing loss of time until it was repaired and replaced but also causing the loss of idlers and other conveying equipment, not to mention the purchase of large quantities of repair plates and fasteners.



● To prevent cement from sticking in the skip of a mixer, a metal weight can be hung on the inside of the skip as shown here. When the load is poured into the mixer a slight movement of the skip swings the "knocker" and dislodges any remaining material.

● The turntable for trucks shown here was used to good advantage by J. F. Roberts on a highway job between Colorado Springs and Pueblo, Colorado.

Must Bidder "X-Ray" Site?

Before a Texas state highway contract was entered into it looked as if it would involve removal of about 17,412 yards of solid rock, as against 53,585 yards of common earth. When the job was finished more than double the estimated quantity of rock had been taken out, and only about 40,000 yards of earth. Under permission from the Legislature, the contractor sued for extra compensation, on the ground that the highway officials had misrepresented subterranean conditions. The contractor lost his suit before the district court at Austin, and the Texas Court of Civil Appeals okayed the decision. (Powell v. State, 118 S. W. 2d, 960.)

Bids had been called for on a classified basis, under which the "approximate quantities" of rock and earth were respectively estimated as above stated. Before the bids were opened, however, Contractor Powell was notified that the project had been changed to an unclassified job. This left insufficient time to explore the terrain, and reliance was placed upon a state engineer's statement that soundings and borings had been made, and that he thought the quantities estimated were approximately correct. The contractor was awarded a contract for "unclassified roadway excavation" at 35 cents per yard.

The Court of Civil Appeals recognizes the general rule that a public contractor can recover extra pay for extra work necessitated by positive misrepresentations made to him as to subterranean conditions. In this instance the court ruled that circumstances of the case did not show such misrepresentations, and that the case fell within those other rules of law: "Where one agrees to do, for a fixed sum, a thing possible to be performed, he will not be excused or become entitled to additional compensation, because unforseen difficulties are encountered.

"In order for plaintiff to be entitled to recover damages for extra expenses incurred by him as alleged, it must appear that the so-called representation (as to

(Continued on page 294)

EXCAVATING ENGINEER

A Monthly Publication
Devoted to the Excavating Industry

The Excavating Engineer Publishing Co.
South Milwaukee, Wisconsin

F. O. WYSE, *Manager* — ARNOLD ANDREWS, *Managing Editor*
D. B. REED, JR., *Editor* — M. J. BARGENQUEST, *Assistant Editor*
JOHN I. MORAVEC, *Art Director* — DELMAR COHEN, *Assistant Editor*
E. M. HEUSTON, *Advertising Manager* — H. J. MASUHR, JR., *Assistant Editor*

Residential Construction at Highest Level Since 1929

March residential contracts, despite severe storms and a delayed spring, rose to the highest level on record since October, 1929. The gain over the March, 1938 total for the 37 states east of the Rocky Mountains amounted to 58 per cent, according to F. W. Dodge Corporation. The gain of 59 per cent over February, 1939 was somewhat more than the usual seasonal increase.

Total contracts for all classes of construction started during March, amounted to $300,661,000 which represented a gain of 32% over March of last year and a further gain of 36 per cent over February of this year. All major classes of construction contributed to these gains.

During the past month, the volume of F.H.A. mortgages accepted for appraisal have risen each week with almost continuous regularity. The total of $29,457,028 reported for the final week of March by the Federal Housing Administration was the highest amount for any week on record. These gains may presage further expansion in residential building as the year progresses.

Total construction contracts for the first quarter of 1939 have reached the highest volume in eight years. The gain over last year amounted to 44 per cent, while the increase over the first quarter of 1937, which represented the previous high point in the recovery period, amounted to 17 per cent. In residential building, the contract total for the first quarter represented a ten-year peak. The gain over the corresponding period of last year amounted to 83 per cent, and over the first three months of 1937 to 23 per cent. In non-residential building, corresponding gains over the first quarter of last year amounted to 30 per cent while contracts for public works and utilities were 25 per cent ahead of the first three months of 1938.

Further analysis of the construction record on the basis of ownership, reveals the fact that private building has shown far greater gains than public construction. For private work, the March record was 58 per cent ahead of February while public work showed a corresponding gain of only 16 per cent. At the end of the three-months' period, private construction was 40 per cent above last year. On the other hand, public construction, because of the unusually low totals during the early months of last year, registered a 47 per cent gain over the first quarter of 1938.

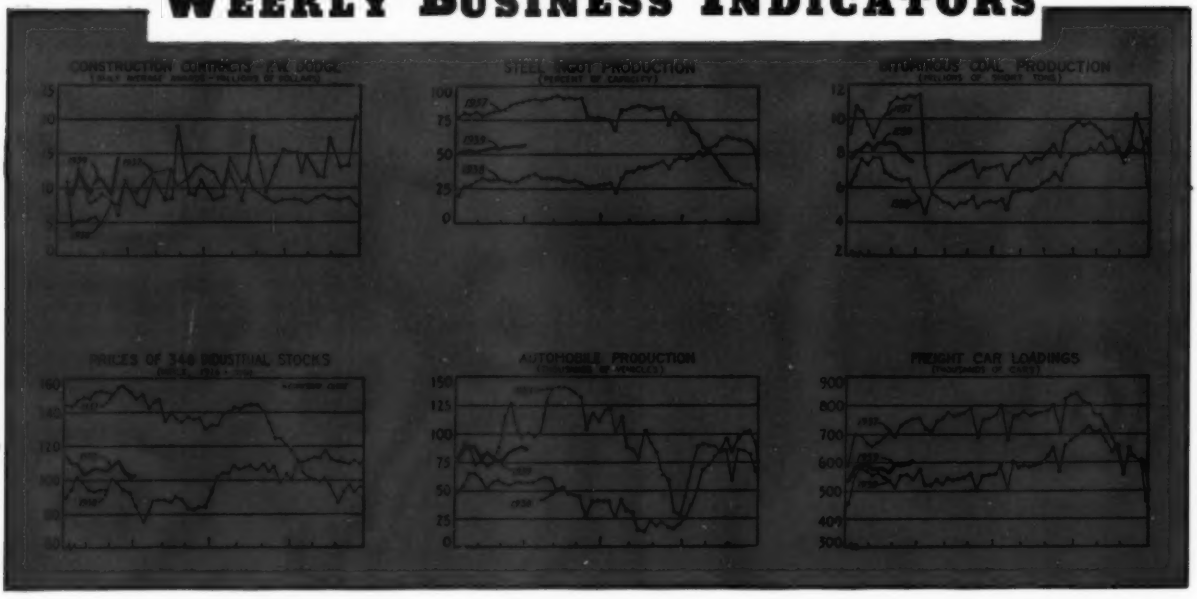
Business System Editorials

The editorial "The Competitive System" which appears on the next page is the tenth in a series of twelve articles explaining the American business system. The nine articles which appeared in previous issues are:

Who Are Business Men?
Building a Business.
When A Business Grows.
Who Puts Up the Money?
Who Owns Business?
Should Business be Big or Little?
Who Pays the Taxes?
Who Determines the Wages of Employees?
What is Management?

Reprints of all these editorials and the two yet to be published are available for you at one cent per copy in lots of ten. Orders for ten copies of a single reprint are the smallest we can handle. Thus, if you want only ten copies of an article just send ten cents and tell us which one you want. If you wish to have the whole series, send $1.20 and we will forward ten copies of each of the ten articles published thus far. Copies of the remaining editorials will be sent to you as soon as they are off the press each month.

WEEKLY BUSINESS INDICATORS



The Competitive System

IT TAKES all kinds of people to make a world. Most people are friendly, sincere, and honest, but every community has a sprinkling of people who are selfish, who are not sincere, and who are not entirely honest. And these insincere and unethical people can be found in all groups of our economic society.

Any group of employees is likely to contain one who will attempt to grind his own axe at the expense of the others. Any neighborhood may contain one person who will try to impose on the rights of his neighbors to further his own interests. Any group of business men may contain one who will follow unethical practices in an effort to gain an edge over his competitors or over his employees. Any group of politicians may contain some who will double-cross their associates or their voters to gain money or power. There is no group of employees, or employers, or customers, or politicians that is entirely good or entirely bad.

The fellow who crowds your car and forces you to hit the shoulder of the road, and to put on brakes to avoid an accident, is unethical and selfish; he wants an edge for himself, and he doesn't care what happens to you so long as he gets it. And you will meet such fellows in all kinds of cars—in old stripped Fords that cost twenty-five dollars, in used jobs that cost two hundred dollars, and in shiny new cars that cost over a thousand dollars. Selfishness is not confined to any particular price class, nor to any particular wage or salary level.

The fellow who welshes on his obligations is selfish and dishonest—and he can be found in all kinds of surroundings. He may earn twelve dollars a week, or thirty, or a hundred, or a thousand; he may be a drug clerk, a truck driver, an operator, a superintendent or a Congressman. Every nation, state, city, and town, since the world began, has had some such people among its citizens, and always will have them. The honest people, who outnumber the unethical people, must find ways to deal with them.

The citizens of a competitive democratic society have the power to control and to penalize selfish, unethical, and dishonest people.

Employees get wise to the fellow-employee who slyly evades his responsibilities, and makes the rest of them carry his load. Employees penalize such a fellow in many ways. Employees also penalize foremen and superintendents and employers who are stupid, selfish, or unfair.

A selfish and unfair man in a community will be penalized by his neighbors. They will band against him, unconsciously or consciously, resist his selfish efforts, omit him from their affairs, and "job" him. When everything is added up, he gets more of a trimming than he gives.

A contractor who continually bids below his costs just to get the business may get by temporarily, but eventually he gets disciplined and penalized by associates, by competitors, by customers, and by employees. His competitors go out of their way to trap him, and to show him up; his customers force him into still more unprofitable deals, or take their business to his competitors who give a better job along with a fair price; the banks and his sources of supply learn that he can't be trusted, and so restrict or cut off his credit. Eventually he gets thrown out and replaced, or he loses his shirt or he winds up with a small and broken business that hardly keeps him alive.

The power of independent and democratic people to penalize selfish and dishonest persons is called "the power of public opinion." The public is usually slow about using this power, and consequently unethical people can sometimes get by for quite a while. But when the public chooses to use its power, it can, and does, ruin the people who misbehaved.

The people of the United States are patient and, in social and economic affairs, they are very often lazy, and so their use of the power of public opinion is not thoroughly efficient.

Consequently, the society, the business, and the politics of the United States are imperfect. Yet with all of the imperfections, the people of the United States have had a personal and political freedom that is unsurpassed anywhere in the world; they have received more money, more necessities, more conveniences, and have enjoyed a more comfortable living scale than the people of any other nation. All these combine to give the average American a more abundant life than has ever been experienced by any other people at any time in history.

Competition for public office forces politicians to watch their step, and permits the people to control them. Competition between the businesses for the trade of customers gives the customers a control over business. Competition between businesses for efficient workmen permits the employees of the United States to retain their independence.

Competition between the executives of businesses for jobs, for customers, for employees, and for the money of investors makes it possible for business to discipline and penalize unethical operators.

Thus the competitive system gives the people of the United States the privilege of disciplining unethical groups by application of the power of public opinion. And so long as competition exists, that power will be held by the people.

But if the competitive system should be abandoned and replaced by a paternalistic planned society, the control of all affairs and all individual actions of the people of the United States would necessarily centralize in government and could no longer be held by the people.

In that case, the greatest opportunity to get power and money would be in government work. Then the most selfish of the workmen, and the most selfish of the business men, and the most selfish of the politicians would use their ingenuity to get government jobs so that, in a non-competitive system, they could feather their nests. The result would be that we would find the selfish and unethical people controlling the government, and holding the power to do what they wished with the rest of us.

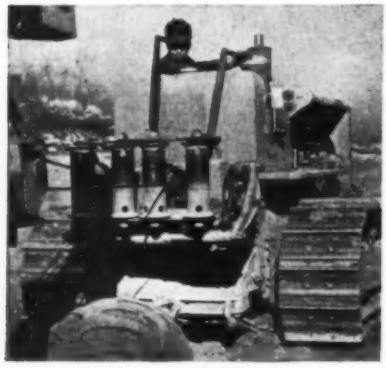
Equipment

you ought to KNOW ABOUT

Cable Controls

To facilitate the handling of cable-controlled scrapers, bulldozers and other equipment, Caterpillar Tractor Company has announced a new double drum cable control attachment for use on "Caterpillar" track-type tractors.

The mounting of the control unit leaves the tractor drawbar clear, facilitating the hooking and unhooking equipment.



Better spooling is provided by increasing the distance between the drum and the first bend in the cable. It is claimed time studies show greatly increased cable life due to this type of construction.

Passenger All-Wheel Drive

To solve the problem of the oil scout, the mining engineer, the timber buyer—and a host of other hardy men who spend most of their time out in desert or wilderness where pavements or even roads have never caught up with them, Marmon Herrington announces that their all-wheel drive principle is now being applied to standard Ford light delivery, commercial and passenger car models.

New Diesel Oil

After 10,000,000 test miles—after 90,000 test hours—Standard Oil Company of California is announcing its New "RPM" Delo (Diesel Engine Lubricating Oil).

Standard Oil engineers claim that this New "RPM" Diesel Engine Lubricating Oil will bring the maximum service benefits of correct lubrication to all Diesel engines, regardless of size or design. These scientists stress the point that now giant Diesels in power and industrial plants, small high-speed Diesels in trucks and buses, rugged Diesels in tractors and aboard ships—every one—can derive full lubrication protection from its proper S.A.E. grade of New "RPM" Delo.

High Pressure Hose

Featuring its newly designed Indestructible High Pressure Spray Hose, New York Belting & Packing Company of Passaic, New Jersey, recently announced its 1939 line of spray hose covering all the requirements for the various pressure services.

According to the general manager, this newly designed 800-pound hose is made of a high grade tube that resists deteriorating action of spray solutions; is composed of three braided plies of super-strength yarn, particularly developed for high pressure work; and has a cover of a high grade black abrasive resisting stock. This hose is made in sizes $\frac{3}{8}$", $\frac{7}{16}$", $\frac{1}{2}$" inside diameter.

Improved Conveyor Belt

Improved conveyor belt construction, embodying a feature designed to withstand unusually severe service conditions, has been announced by the Mechanical Goods Division of United States Rubber Company.

The refinement, it is claimed, is accomplished by imbedding a special weave breaker-strip fabric in a heavy layer of soft white gum. This layer is inserted next to the belt carcass as an integral part of the belt cover, and provides a shock absorbing cushion for the belt cover. Because of its ability to absorb the shock of heavy impact this new type of construction increases the effectiveness of the cover in resisting the gouging, snagging and other severe wear encountered in heavy service.

All Angle Milling

From Fray-Mershon, Inc., Glendale, California, comes the announcement of the manufacture of the "All Angle Full Universal Milling Machine."

The tool, the general operation of which is in connection with horizontal mills, is made in two types; one with and one without a 4 inch spindle travel. Once installed on milling machine overarm bar, there is no occasion to remove the "All Angle Machine" as it can readily be swung up and back on the bar out of the way where it never interferes with the use of the mill itself.

Dodge Trucks

Streamlined from bumper to bumper in a refreshing, eye-pleasing style and incorporating engineering features made possible by a giant new truck plant, Dodge Truck Division of Chrysler Corporation expects to pace the commercial transportation field in 1939 with its full new line of trucks. A radically changed grille and a sloping, one piece V-shaped windshield that opens, are front-end changes lending grace and symmetry to the 1939 Dodge trucks.

Another highlight in Dodge's 1939 program is the introduction of a Dodge Diesel truck in the 3-ton line. Of considerable inter-

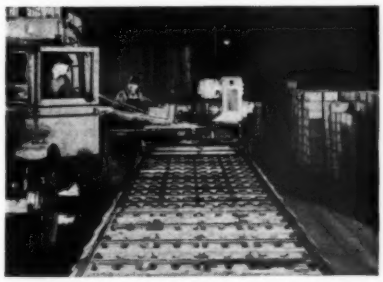
est is the announcement that Dodge this year offers new Dual-Purpose models in 1½-ton heavy duty and 2-ton models for use where unusual flexibility is required. A two-speed axle installed in the Dodge factory is available in two combinations of ratios, gives each model at least 8 speeds forward and 2 in reverse. Ratios are 5.14/7.15 and 5.83/8.1. Time tested economy features of Dodge truck's 6-cylinder L-head engines, are continued in the 1939 motors.

Prefabricated Concrete Units

With the announcement of the organization of the Cemenstone Corporation, which will engage in a nation-wide standardization of prefabricated concrete units, it has been revealed that the D. J. Kennedy Company of Pittsburgh, the corporation's first licensee, has just gone into steady production of standard precast concrete shapes, which simplify fireproof construction and lower its cost through mass production.

The Cemenstone Corporation will not manufacture precast concrete products. It will supply its patented equipment to licensees in designated areas, throughout the United States, who will be granted exclusive rights to manufacture, under the company's patents and its trademark "Cemenstone." Products will be made according to the corporation's established standards of quality. It is said that by this means it will be possible for architects, contractors and owners to obtain products of known quality and utilization throughout the United States.

Use of vibration, heat and mass production methods are the three main features of the Cemenstone system of manufacture. Vibration while molding is said to produce a



finer texture and a stronger product. Heat is used to hasten the chemical reaction of the cement when it is brought in contact with the other materials and water. It also is said to induce uniform shrinkage and a product of a uniform light color. Mass production has been made possible by the development of a system which permits rapid cycles of manufacture and the making of several shapes at one operation. The method of molding, curing and aging produces elements with sharp edges and corners so that they have the appearance of cut stone, it is claimed.

Among the products which can be produced by this method are blocks for wall construction and channel-shaped, short-span slabs for floors and roofs, as well as long-span slabs, concrete plank, joists, brick, insulating tile, and veneering, also curbs, sidewalks, fence posts. The veneering will be capable of taking a large number of surface treatments. In addition to being cast in colors, their surfaces can receive stains or paints satisfactorily and other materials can be molded to their surfaces. It also is planned to produce blocks inserted with glass panels so that they will not only be load bearing wall units but will admit light. They will be developed for air-conditioned buildings and for structures which require the elimination of outside dirt and dust and to admit light through basement wall structures.

Worthington Diesel

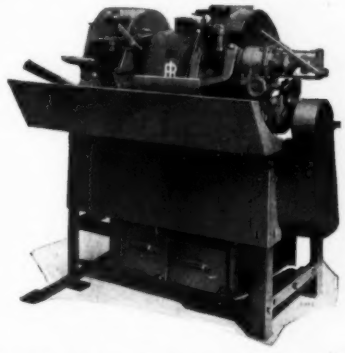
Worthington Pump and Machinery Corporation of Harrison, New Jersey, has announced a new type CC totally enclosed, direct-injection Diesel engine. Of the four-cycle, trunk-piston type, using a direct fuel-injection system, the new engine is of the simplest and most compact design consistent with high efficiency and complete accessibility, it is claimed. All moving parts are wholly enclosed.

The cone-type cylinder head featured in the CC engine is a Worthington development which has eliminated the possibility of head breakage due to load and temperature stresses. Full provision for expansion is made in this construction, and the need for a gasket between the cylinder head and the liner is abolished.

This engine is adaptable to pumps, compressors and other power drives. It is particularly suitable for rock products plants, oil field work, grain mills, excavators and other similar installations where quantities of abrasive materials may be present in the air.

Jackbit Grinder

A new semi-automatic high-production Jackbit grinder has just been announced by Ingersoll-Rand. Known as the size J-5, this one-man machine is capable, it is claimed, of increasing production to 60 average hard bits or 100 average annealed bits per hour.



Gauging is done automatically while the operator is forming the face of the bit.

This new machine is adaptable for use with all types of standard detachable rock-drill bits and is particularly suitable for use by mines, quarries and contractors.

Detailed information is contained in an eight-page bulletin, form 2534, copies of which are available from the Ingersoll-Rand Company, 11 Broadway, New York City, or any of their branch offices.

Portable Compressors

A new line of two-stage, air-cooled portable compressors in which a number of improvements have been incorporated has been introduced by Ingersoll-Rand. These machines are available in five sizes for actual capacities of 85, 105, 160, 210 and 315 cfm of air at 100 pounds pressure. They are powered either by Waukesha heavy-duty industrial type gaso-

(Continued on page 302)

NOT in the Contract

A hotel was on fire and the guests, gathering out in front were watching the flames.

"Nothing to get excited about," one traveling man was boasting, "I took my time about dressing. Lighted a cigarette. Didn't like the knot in my necktie and retied it. That's how cool I was."

"Fine," remarked a bystander, "but why didn't you put your pants on?"

WPA Executive: "If we don't figure out a way to spend that one hundred and twenty million dollars, we lose our jobs!"

Secretary: "How about a bridge over the Mississippi — lengthwise?"

Teacher—William, what are the two genders?

William—Masculine and feminine. The feminine are divided into frigid and torrid, and the masculine into temperate and intemperate.

Molly had a little dress,
A pink one—rather jolly.
It didn't show the dirt a lot,
But, gosh—it did show Molly.

Old Lady (to street-car motorman): "Please, Mr. Motorman, will I get a shock if I step on the track?"

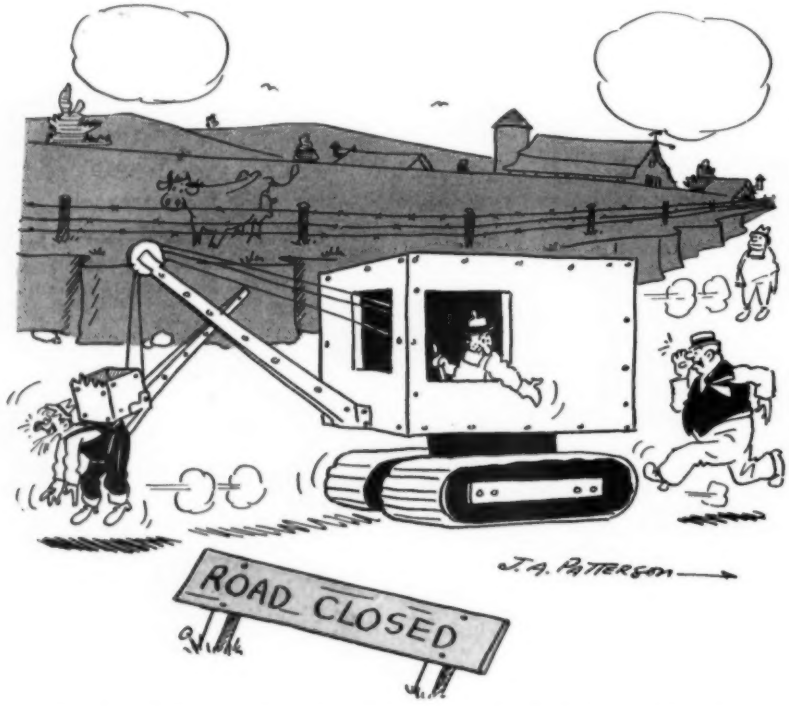
Motorman: "No, lady. Not unless you put your other foot on the trolley wire."

Most men like to fiddle around a while before making overtures to a girl.

Burglar (caught in old maid's room): "But, lady, honest, I never did anything wrong."

Old maid: "Well, it's never too late to learn."

The modern optimist is the fellow who thinks his wife has quit cigarettes when he starts finding cigar butts around the house.



"But boss, he's my uncle an' he only lives a couple of miles down th' road."

First nurse: "There's a patient in my ward that hasn't tried to make love to me."

Second nurse: "Yeah, one of mine is still unconscious, too."

A Persian pussy, perfumed and fair
Strolled out of the kitchen door for air;
Her story, briefly, if you wish
Was that she was feeling kittenish.

When old maids look under the bed, they are usually looking for one sort of mug or another.

"Now," said the youth, after getting his father seated at the football game, "you'll see more excitement for two dollars than you ever saw before."

"I don't know," replied the old gent. "That's what my marriage license cost."

One afternoon on the veranda of a hotel a beautiful young woman and her little six-year-old son sat near a man. The little fellow trotted over to the man who patted him on the head inquiring: "What's your name?" After he told, the boy lisped, "Is you married?". "No, I'm not," was the reply. Then the child paused a moment and turning to his mother said: "Mother dear, what else did you tell me to ask him?"

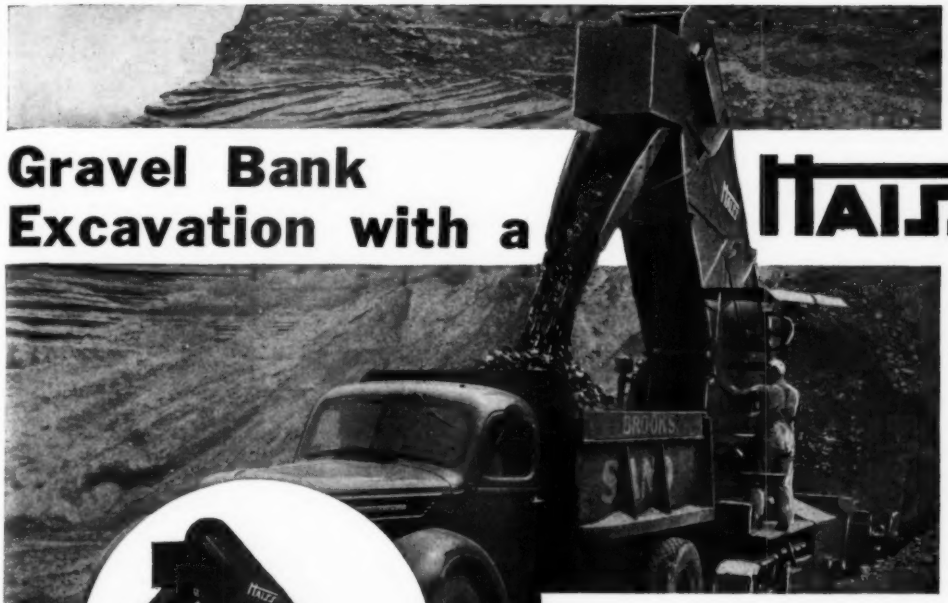
Salesman (beginning to unroll his samples): "I'd like to show you—"

Contractor (emphatically): "No, no, I'm not interested.

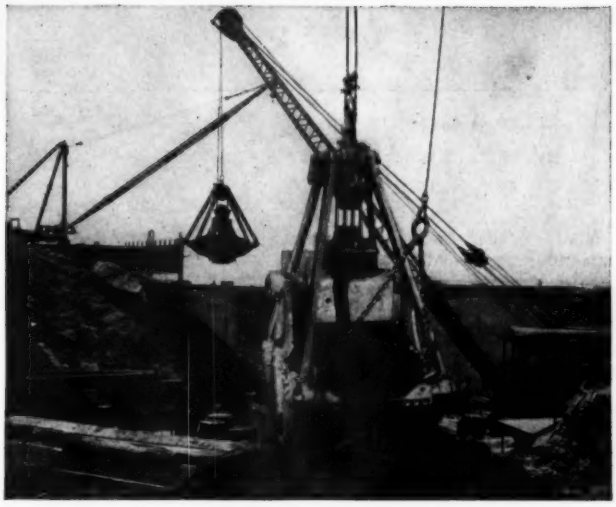
Salesman (eagerly): "But couldn't I just show you—"

Contractor (firmly): "Not a chance. I'm not interested."

Salesman (wistfully): "Well, would you mind if I looked at them myself? I haven't had a chance to see them for three weeks."



Gravel Bank Excavation with a HAISS MODEL 80



. . . a high production low cost job

From the standpoint of purchase price, operating cost, efficiency, flexibility, close clean-up, and clean level floor—from all of these the Haiss Loader will prove itself your first choice. Cobble guard plates and avalanche protection extend its usefulness to all except the most tightly cemented and big boulder filled banks . . . There are 4 great Haiss Loaders for bank excavation, stockpile loading and general service. Capacities range from 2½ to 8 yards a minute. Big-capacity machines which put loading on a bed-rock economy basis. Ask us to send you a set of 1939 Specifications.

The HAISS HI-POWER, too, is TOPS in its field!

A bucket that has crane operators talking about it wherever it goes on the job. Speed and power in rare combination. Has won "bouquets" of praise on underwater work, dredging bridge pier foundations in 45 feet of deep water. A bearcat at gripping hold of difficult boulders — as letters on file bear repeated testimony. Digs deep and brings out a full pay load. A bucket with which to make money in tough ground . . . Prices and descriptive bulletins on request.

HAISS

WHO FOR OVER 45 YEARS HAVE CREATED AND SOLD NONE BUT EQUIPMENT OF DEMONSTRABLE SUPERIORITY IN DESIGN AND MANUFACTURE

Stocked in New York, Philadelphia, Baltimore, Atlanta, Hartford & Los Angeles

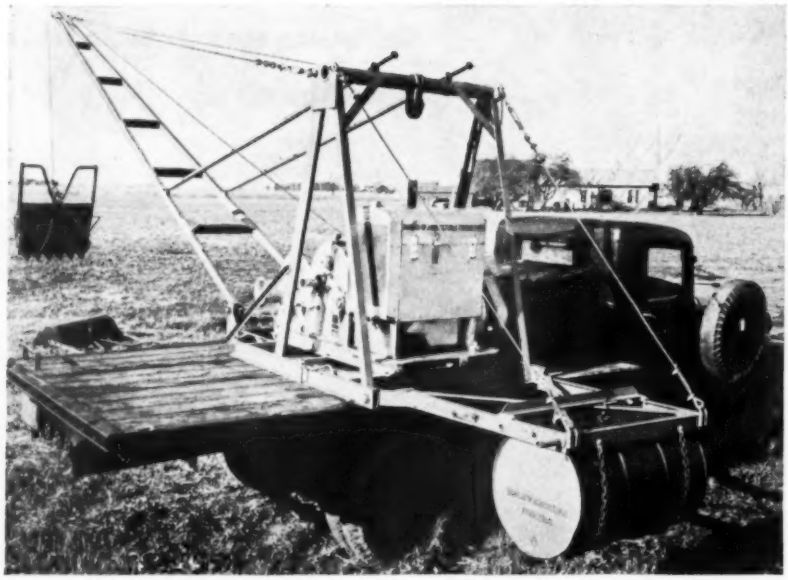
GEORGE HAISS MANUFACTURING CO., INC.

144th Street and Park Avenue, New York, N. Y. *Distributors Everywhere*

ALSO PORTABLE BELT CONVEYORS, REVOLVING SCREENS, ELEVATORS & CONVEYORS, HOPPER GATES

For your convenience in writing to the George Haiss Manufacturing Co., Inc., you will find a card bound in this issue.

Shots from the FIRING LINE



● A close-up view of the unique ditch digger and scraper. Note the steel teeth on the scraper.

Unique Ditch Digging Machine and Scraper

By F. N. Hollingsworth

A unique ditch digging machine, suitable either for use in digging and cleaning out roadside ditches or the more extensive field ditches has recently been developed by the Bureau of Agricultural Engineering of the United States Department of Agriculture. The machine was conceived in, and is now being tested in CCC camps around the northern parts of Indiana and Ohio.

This ditch digger saves a vast amount of time and hand labor, enabling more ground coverage and freeing the works for other tasks. It is a complete unit and can be mounted on, or easily removed from, practically any make of truck of at least 1½ tons or larger, depending upon the type of soil in which the digger has to work.

Construction of Ditch Digger

The new ditch digger consists of a double drum hoist unit, a subframe and standards to support a boom and counter balance, and a side cleaning scraper of five to seven cubic feet capacity. The apparatus is mounted crosswise of the truck bed to permit side cleaning work. A twelve to eighteen horsepower gasoline engine driven hoist with a bare drum rope speed of about a hundred feet per minute has been found satisfactory.

The 25-foot boom is supported from one side of the truck at an angle of 25 to 30 degrees from the horizontal. Diagonal tie bolts from the frame of the attachment to the main frame members of the truck relieve the truck bed of excessive strains. The boom is erected into and lowered from working position with power of the hoist unit, the outhaul cable, passed over an auxiliary sheave at the top of the boom supporting framework being utilized for this operation. For highway travel the boom is carried in special brackets at the side of the truck.

Handles Ditch Work Economically

Special cut-away handles have been provided for the scraper to prevent interference with the cables when the scraper is dumped. Tests have shown that the machine will handle ten to fifteen cubic yards per hour in scraping out a ditch at a cost of 25 to 35 cents per cubic yard. This type of excavator is superior to tractors in that hand dumping and hand return of scrapers is eliminated, while the machine can easily be moved from one job to another, along a highway or over a rough field, the truck also being usable at any time for other work upon removing attachment. truck is estimated at $1,000 with net weight 3,000 to 3,500 pounds. The machine works to best advantage where the bottom width does not exceed three feet, which is about the width of the average roadside ditch, and where the depth is not more than six feet, and where the quantity does not exceed forty cubic yards per 100 feet.

● General view of large field with the new ditch digger working on a drainage ditch.

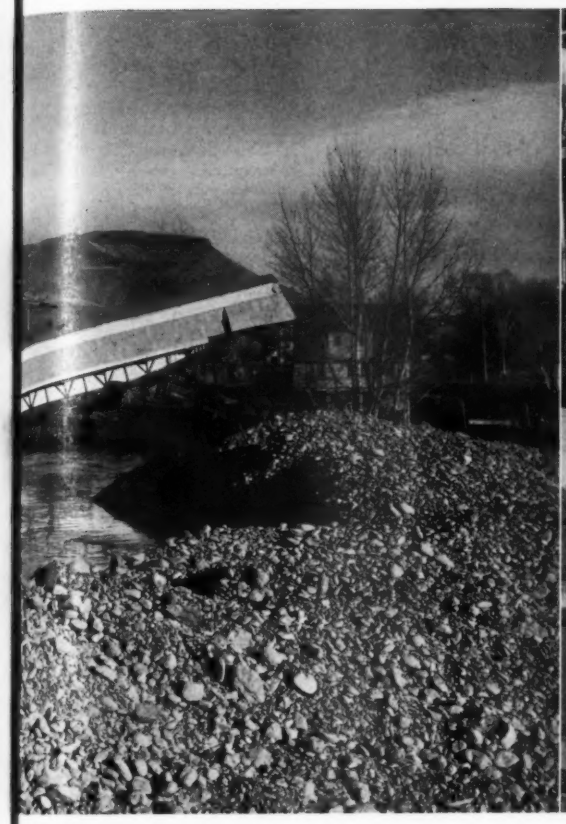
Tin Mining On the Island of Banka

On the island of Banka in the Netherlands East Indies the Dutch Government is using a 32-B Ruston-Bucyrus electric dragline on Caterpillars for stripping overburden on a tin mine and loading tin wash to the washing plant. The dragline is equipped with a 50-foot boom and uses a ¾ cubic yard bucket.

Working in the overburden, which is easy digging, the Chinese operator has been able to get 65 cubic metres (85 cubic yards) per hour overcasting. In digging the gravel tin wash the output averages about 38 cubic metres or 50 cubic yards per hour, working 16 hours per day in periods of 31 days. Capacity here is limited by the capacity of the

(Continued on page 274)

lter Johnson's Choice



Walter W. Johnson Company
ting at John Day, Oregon.

Atlas Diesel Electric power plant in a 2½ cubic foot dredge operated by the Boundary Dredging Company in Canyon Creek, Forty Mile District, Alaska.

Revolving Screen as employed in a 6 cubic foot dredge.

This is a 2½ cubic foot dredge with mechanical drive, Atlas Diesel powered, operated by the Bristol Bay Mining Company in Wattamuse Creek, Goodnews Bay District, Alaska.

pecially when designing equip-
conditions in inaccessible loca-
n of wide experience are con-
rove very costly.

ence — that's the keynote of
W. Johnson Company, San
Walter W. Johnson has de-
s, ranging in capacities from
have been shipped throughout
oreign countries.

for his dredges, Mr. Johnson's
erience he has had with Atlas
ngines. During the past three
to Johnson Dredges — a silent
a, dependability and economy

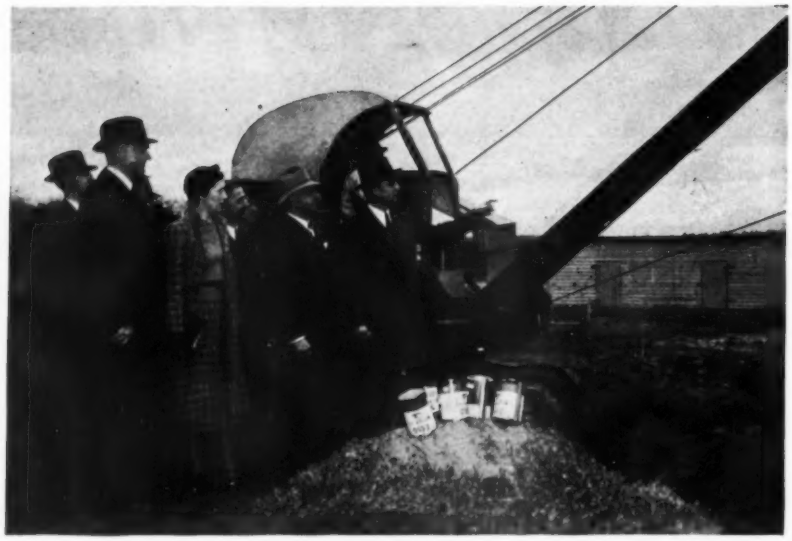
EL ENGINE CO.

Western Division
Navigation Blvd.
uston, Texas

Western Division
1000 Nineteenth Ave.
Oakland, California

- Charleston - Miami - Jacksonville
- Terminal Island - Seattle - Portland
olulu - Manila.

:SEL ENGINES



● Nathan Straus (pointing), administrator of the United States Housing authority, on a recent inspection trip at the Olmstead housing project is accompanied by the various officials of the Augusta Housing authority, Augusta, Georgia. Lokey and Anderson of Thomson, Georgia are operating a Bucyrus-Erie 10-B dragline on the job.

(*Continued from page 270*)

gravel pump which takes the material to the washing plant.

Increased production made possible by the use of the dragline reduces production costs even below those of having the work done by Chinese Coolie labor.

Increase Housing Loans

With the announcement of seventeen additional low-rent housing loans totaling $31,416,000 on March 30, Administrator Nathan Straus of the U. S. Housing Authority briefly reviewed the progress of his agency during the past two months.

Main construction contracts have been awarded on 19 projects in 14 cities and projects in four communities—Austin, Texas, Jacksonville, Fla., Buffalo N. Y., and New York City—are approaching completion. Costs of construction have shown a steady downward trend, and the estimated cost in one of the newly-approved developments, Atlanta, Ga., establishes a new all-time low of $3,079 per dwelling unit as the overall cost, including land.

Since Jan. 1, legislation permitting the formation of local housing authorities has been enacted in the states of Washington, Idaho, Arizona and New Mexico, bringing the total of states with such legislation to 37; five more states are expected to act shortly. Court tests of such laws have resulted in their approval by the highest courts of eleven states, with no adverse decisions.

With all present funds allocated, USHA has on hand unfulfilled applications for loans aggregating approximately $400,000,000. Congress is now considering a bill by Senator Wagner increasing the maximum amount the agency is authorized to loan from $800,000,000 to double that amount. The 17 new contracts announced were:

City	Total Overall Cost	No. Families
Los Angeles, Calif.	$2,771,000	610
San Francisco, Calif.	8,835,000	1,778
Athens, Ga.	696,000	170
Atlanta, Ga.	3,723,000	1,207
Augusta, Ga.	1,098,000	254
Macon, Ga.	1,825,000	410
Laurel, Miss.	965,000	275
McComb, Miss.	311,000	76
Great Falls, Mont.	703,000	157
Camden, N. J.	1,424,000	275
Long Branch, N. J.	607,000	120
Wilmington, N. C.	745,000	188
Cincinnati, Ohio	1,476,000	316
Philadelphia, Pa.	5,552,000	950
Memphis, Tenn.	2,474,000	478
El Paso, Tex.	1,331,000	314
Martinsburg, W. Va.	383,000	100
	$34,919,000	7,678

Ft. Peck Project Gets Early Start

The early opening of the working season has permitted excellent progress to be made on the Fort Peck Project, including the reconstruction on that portion of the upstream section of the dam near the east abutment which was involved in the slide of last September. Work is being done in accordance with the recommendations of the Board of Consulting Engineers which, for five months since the occurrence of the slide, has been studying the data obtained from exhaustive explorations and tests that have been in progress since September 22, 1938. Two dredges, with pipe lines averaging over 20,000 feet in length and lifts averaging 230 feet, were pumping fill into the additional upstream berm by March 15, 1939, in an effort to complete this year the 12,500,000 additional yards of hydraulic fill recommended by the Board. This berm is being added to the lower portion of the upstream slope of the main dam for the purpose of flattening the present average upstream slope and providing additional stability.

Between March 15, and April 6, 1939, over 900,000 cubic yards of fill were placed and very satisfactory progress has been achieved on the other features involved in the reconstruction program. On the west end of the dam, 64,000 cubic yards of field boulders and 58,000 cubic yards of quarry rock have been salvaged from the area that will be covered by the additional upstream berm. In the slide area, operations on the steel sheet pile cut-off wall, which connects the undisturbed core of the original dam with the rolled glacial-till core of the reconstructed section, are proceeding smoothly, with 107,000 square feet now in place. Glacial till, which is secured from borrow pits on the west abutment downstream of the dam, is being moved by means of shovels and trucks to the rolled glacial-till core in the reconstructed section. In connection with the placement of the glacial till, it has been necessary to excavate 50,000 cubic yards of sand.

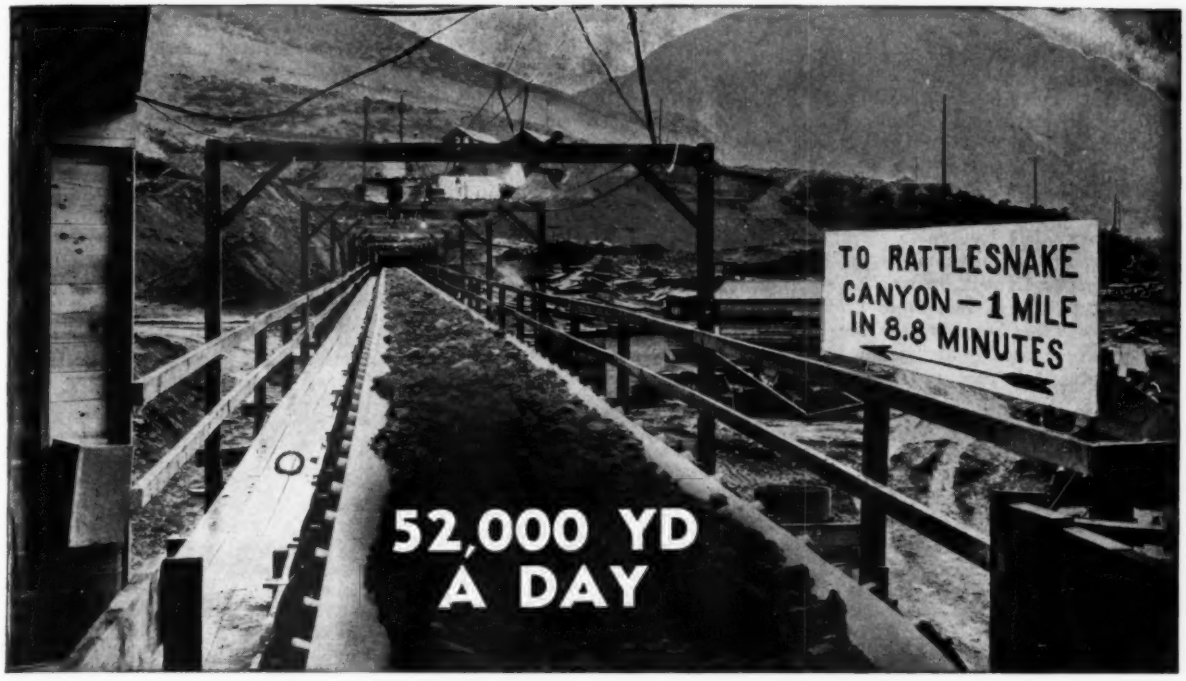
Immediately after the occurrence of the slide, operations were started on cleaning up the slide area. Forty-nine thousand cubic yards of field boulders and 32,000 cubic yards of quarry rock were salvaged, and items of equipment were reclaimed where economically justified. Two million three hundred sixty-four thousand cubic yards of dredge fill were placed in the slide area in the fall of 1938 to provide adequate protection against possible high water in the spring of 1939. Also, in the fall of 1938, 1,307,000 cubic yards of hydraulic fill were placed in the upstream berm on the west end of the dam.

To Excavate 735,000 Yards

One of the large items involved in the reconstruction program is the excavation of 735,000 cubic yards of shale above the tunnel intakes to flatten the existing slopes there. This work was started in January 1939, and, to date, 444,000 cubic yards have been removed.

The reconstruction program to be carried out under the recommendations of the Board can be better appreciated by a statement of the quantities remaining to be accomplished. In the remainder of the 1939 working season, it is proposed to place 11,587,000 cubic yards of dredge fill; to haul in and place 833,000 cubic yards of sand; to place 240,000 cubic yards of rolled glacial-till core; to complete the cut-off wall, which will require the placing of 55,000 additional square feet of steel sheet piling; and to complete the shale excavation above the tunnel intakes. This will leave to be done in the 1940 working season the movement of 1,704,000 cubic yards of sand fill and the placement of 29,000 cubic yards of rolled glacial-till core.

The total dredge fill that is now in



Moving a Mountainside on a Modern Magic Carpet

GETTING down to granite for the foundation support of Grand Coulee Dam required the excavation of 13,000,000 cubic yards, and, for carrying this spoil, a continuous conveyor system more than a mile long, leading up into a distant canyon, was called for.

To handle this record job, the contractors, the Mason-Walsh-Atkinson-Kier Company, and the Jeffrey Manufacturing Company planned the largest and swiftest belt-conveyor system ever built.

Equipped with a General Electric drive and control system, the success of this conveyor was immediate and continuous. It carried 52,000 cubic yards a day.

Twenty-five 200-hp G-E motors operated the individual conveyor sections, which ranged from 200 to 275 feet in length. Other G-E motors operated the stacker, a shuttle conveyor, and feeders. G-E control placed operation of the entire system at the finger tips of the operator in the control house on the stacker. Operation of the entire conveyor system was electrically interlocked so that a stoppage of any one section automatically stopped all other sections on the incoming side.

The contractors estimate that they saved 60 per cent on the cost of moving spoil by using the electrically equipped, automatically controlled conveyor system.

One of 25 G-E 200-hp motors and part of G-E control operating conveyor system at Grand Coulee Dam

TO GET SPEED FOR THE JOB, COMPLETE SERVICE FOR YOUR MONEY, SPECIFY "GENERAL ELECTRIC"

While there are few projects comparable in magnitude to Grand Coulee Dam, there are many in which new and properly applied General Electric equipment can help contractors save money.

Consult the General Electric sales office in your territory, or write General Electric, Schenectady, N. Y.

011-166

GENERAL ELECTRIC

For your convenience in writing to General Electric, you will find a card bound in this issue.

place and that will be placed upstream of the original design section which was being followed at the time of the slide is approximately 16,000,000 cubic yards. This includes the 5,250,000 cubic yards of material that moved in the slide which is now upstream of the original design section. The placement of this material will result in a berm from the valley surface at elevation approximately 2,050 feet up to elevation 2,162 feet on the upstream side of the main dam throughout its length. The slopes of this berm vary from 1 on 7 to 1 on 50. This berm will be considerably larger at the abutments than at the center of the dam.

Low Bids on Sideling Hill and Laurel Hill Tunnels

An unofficial low bid of $2,445,851 was submitted to the Pennsylvania Turnpike Commission by Arundel Corporation, Baltimore, Maryland, for excavating Sideling Hill tunnel in Fulton County.

The tunnel is the first of eight to be used by the 160-mile super-highway between Harrisburg and Pittsburg.

A total of 10 bids were opened. The highest proposal amounted to nearly $3,500,000.

The Sideling Hill job, which also includes grading of the east and west approaches, involves 140,000 cubic yards of excavation. Other principal items include approximately 97,000 cubic yards of concrete and more than 3,000,000 pounds of steel.

When completed, Sideling Hill will be 6,626 feet long. The original South Penn railroad builders had drilled 3,247 feet. Of the driven portion, 1,200 feet is double track and 2,047 feet single track.

Construction of this tunnel will save motorists using the Turnpike a climb of nearly 650 feet. The mountain is 1,918 feet high at this point while the tunnel is at an elevation of only 1,277 feet.

Apparent low bidder for excavation of the Laurel Hill tunnel second in the series of eight to be used on the Pennsylvania Turnpike was the Hunkin Conkey Construction Company of Cleveland, Ohio, which asked $1,920,281.48 for the job.

Seven other bids opened by the Turnpike Commission ranged from $1,933,333.33 to $2,329,870. The tunnel is on the Westmoreland-Somerset line.

The Laurel Hill job, involves approximately 515,000 cubic yards of excavation. Amounts of other principal items include approximately about 32,000 cubic yards of concrete and more than 3,000,000 pounds of steel.

When completed, Laurel Hill tunnel will be 4,372 feet long. Of this total only about 800 feet were driven by the original South Penn builders leaving about 3,500 feet to excavate.

Construction of this tunnel will save motorists using the South Penn superhighway a climb of about 350 feet since the top of the mountain towers to 2,800 feet while the tunnel elevation is only 2,456.

Complete New Railroad Tunnel at Shasta Dam

Main line railroad traffic between California and the Pacific Northwest will be diverted under an abutment of the Shasta Dam site north of Redding early this summer.

Southern Pacific trains which now cross the dam site near its base on the west bank of the Sacramento River, will be routed through an 1,820-foot by-pass tunnel which is approaching completion by the Colonial Construction Company under a contract with the United States Bureau of Reclamation.

The tunnel was holed through on the afternoon of March 4, by a dynamite charge which blasted a three-foot opening between the north and south headings. Since then the hole has been widened and the last barrier of rock mucked out, to leave a horse-shoe-shape bore 28 feet high and 26 feet wide.

The tunnel is to be lined its entire length with concrete from 18 to 21 inches thick. Concrete placement is under way at the north end where the portal arch and wing walls have been completed and more than 300 feet of lining has been poured by use of a concrete pump.

The temporary railroad relocation, including the tunnel and approaches at either end, is more than a half mile long and has involved 85,000 cubic

(Continued on page 280)

BECO
HYDRAULIC PRESS
BUCYRUS
ERIE
SMALL and PORTABLE
100 TONS of POWER and UP
For use as PULLER - PRESS - or JACK to save you time and money in dismantling worn-out or broken-down equipment and in reassembling machine parts right in the field. Makes extra profits, too, on other types of lift, pull, or press work.
Manufactured in 100, 150 and 225 ton sizes, the BECO Press can be quickly separated into hand portable units and transported out on the job as well as used in machine-shop repair work. Write now for information about this profitable investment which pays quick dividends.
T-24
Bucyrus-Erie
SOUTH MILWAUKEE, WISCONSIN

For your convenience in writing to the Bucyrus-Erie Company, you will find a card bound in this issue.

10 MILLION test miles before our engineers would say, "Right!" Ninety thousand test hours before our engineers would say, "Unequaled!"

That's the research—laboratory and field—behind our announcement of NEW "RPM" Diesel Engine Lubricating Oil. Absolutely nothing taken for granted! Every point proved, and re-proved.

And NOW—New "RPM" DELO (in proper S. A. E. grades) brings new service benefits to ALL Diesel engines, regardless of type, size or service.

Now *every* Diesel—regardless of horsepower or design—can give clean-engine operation—free rings, clean pistons, unscratched liners, uncorroded bearings, sludge-free peak-power performance plus a new low in cylinder and ring wear. Yes, *any* Diesel engine, large or small! Yes, under *any* service conditions! Yes, in Death Valley or Siberia. Wherever you are—whatever Diesel equipment you operate or intend to buy—New "RPM" DELO will lubricate it!

This outstanding oil gives perfected lubrication for the break-in — fewer overhauls from hard service—less repair stoppage. New "RPM" DELO —for maximum lubrication benefits! In *any* Diesel engine! In *every* Diesel engine!

Ask our Representative or your nearest Distributor to see our Engineers' Report on New "RPM" DELO—complete test data that prove its unequaled performance conclusively. Then, take advantage of the money-saving benefits of this history-making Diesel lubricating oil.

ORDER FROM YOUR NEAREST DISTRIBUTOR AS LISTED BELOW:

IN THE UNITED STATES

"RPM" Diesel Engine Lubricating Oil:

The California Company (Montana only)
Humble Oil & Refining Company
Standard Oil Company (Indiana)
Standard Oil Company (Nebraska)
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

Diol "RPM" Diesel Engine Lubricating Oil:

The Carter Oil Company Tulsa, Oklahoma
Colonial Beacon Oil Company, Inc.
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
Standard Oil Company of Pennsylvania

Kyso "RPM" Diesel Engine Lubricating Oil:

Standard Oil Company (Inc. in Kentucky)

Signal "RPM" Diesel Engine Lubricating Oil:

Signal Oil Company

Sohio "RPM" Diesel Engine Lubricating Oil:

The Standard Oil Company (Ohio)

IN CANADA

"RPM" Diesel Engine Lubricating Oil:

Imperial Oil Company Limited
Standard Oil Company of British Columbia Limited

THROUGHOUT THE WORLD

"RPM" Diesel Engine Lubricating Oil is also available through distributors in more than 100 other countries.

Get in touch with your nearest distributor — for a clean engine, and long hard service with the minimum of overhaul.

RPM
REG. TRADE MARK
DIESEL ENGINE LUBRICATING OIL

New "RPM" Diesel Engine Lubricating Oil now available everywhere in the gray barrel with the blue head.

OF CALIFORNIA

For your convenience in writing to the Standard Oil Company of California, you will find a card bound in this issue.

Shots from the Firing Line

(Continued from page 276)

yards of excavation since the start of work last July. The tunnel passes under the abutment of the dam site a lateral distance of 725 feet from the river.

Walker R. Young, Supervising Engineer, said Southern Pacific trains are expected to use the tunnel for at least two years while a permanent 30-mile railroad relocation is being constructed around the Shasta Reservoir site at an elevation above the future high-water line. Meantime, excavation can proceed at the Shasta Dam site for the foundation for the giant concrete structure which is to be a major feature of the Central Valley Project.

When the high-line railroad is completed and opened to traffic, and the existing Sacramento River Canyon line abandoned, the by-pass tunnel will be available for river diversion while concrete is being raised in Shasta Dam. Eventually the tunnel is to be plugged by a section of concrete 162 feet thick.

Irrigation Canals Not Yet Complete on Owyhee Project

Eager farmers already have settled virtually all the irrigable public land on the Owyhee irrigation project. Homesteaders, many of them from drought areas, have applied for all except 397 of the 12,460 acres of public land which have been made available from time to time on the new project in eastern Oregon and western Idaho. On the last section opened for homestead entry late last year four farmers applied for every unit offered. The new farm units of earlier openings which remain unclaimed are rather rough and difficult to handle.

The State and privately owned lands on the project are also well settled. Only about 4,000 of the 53,000 irrigable acres available on such lands remain unoccupied. The project achieved successful settlement despite high qualifications required of applicants.

For Government land an examining board carefully graded the would-be irrigation farmers on their character, industry, financial condition and past farming experience. For State and other lands a local organization of farmers and business men in the area whose officials serve without pay investigated the applicants. The high type of settler obtained is expected to go far toward ensuring full success of the new project.

Irrigation canals and other necessary ditches on the new project are still incomplete. While homesteaders of the first few sections have had water for four seasons others have been irrigating their farms only two and some only one, and this year 8,000 more acres will receive water.

The Owyhee project will ultimately irrigate 123,000 acres of land. Half of it was previously under irrigation but in need of supplemental water which it will now receive. The remainder was sagebrush. About 80,000 acres of this land lie in eastern Oregon near the Owyhee and Snake rivers and 43,000 are across the State boundary line in western Idaho.

H. B. Blanks

As we go to press we learn of the death of H. B. Blanks on April 12, at Lexington, Kentucky following an operation. An oldtime contractor, Mr. Blanks was especially well known for his activities along the Mississippi River. The funeral was held Friday, April 14, at Vicksburg, Mississippi.

Beavers Aid Conservation

Reestablishment of beaver in Shenandoah National Park, Virginia, is planned by the wildlife experts of the United States Department of the Interior in the near future.

Beaver ponds are used by waterfowl, wading birds, blackbirds, amphibians, reptiles, mammals that depend upon impounded water, and are nurseries of water-tolerant vegetation. Even after the beaver colony has moved on a worthwhile memorial remains. Eventually the abandoned ponds become small meadows. Trees again grow up. The beavers did their bit as landscape artists.

Again GATKE persistence has developed a revolutionary friction product that *advances operating efficiency* to a new, all-time high.

On the toughest applications GATKE 445 Moulded Brake Block has *demonstrated unapproached performance*. The rapid dissipation of frictional heat. Gigantic holding power at all service temperatures. Smooth positive pick-up. Soft, smooth release. Long wear beyond belief. Complete freedom from any tendency to score.

Accurately moulded to fit all types of brakes and clutches, this *modern* Brake Block *challenges comparison* on every application.

Whatever your requirements, write for complete information on the GATKE Product designed to do the job better with reduced maintenance cost.

25th Gatke Anniversary 1914–1939

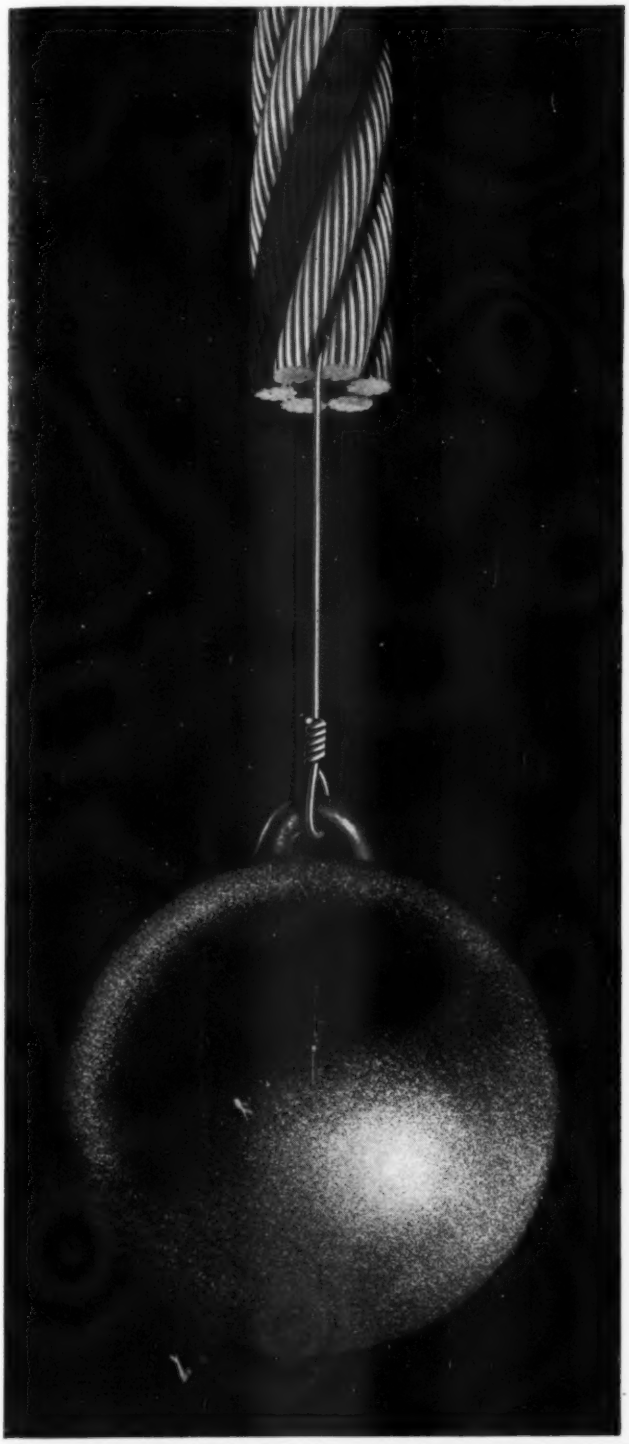
BRAKE BLOCKS AND FRICTIONS

GATKE CORPORATION 228 N. La Salle St., CHICAGO, ILL.

For your convenience in writing to Gatke Corporation, you will find a card bound in this issue.

PURPLE-STRAND *FORM-SET* WIRE ROPE

BETHLEHEM Specify FORM-SET PRE-FORMED ROPE



Made of premium-price extra-tough steel

EVERY pound of steel that goes into Purple-Strand rope would command an extra price on the open market, for extra care and extra time are required in steel-making departments to produce this metal. Special furnaces, reserved for the out-of-ordinary job, are used. Special practices, carried out under strict metallurgical observation, are observed at these furnaces, at the soaking pits, and in the rolling mills.

The result is a superior steel, the first requirement for superior rope. This steel, drawn into wire, has more than four times the strength of structural steel. It has a toughness far exceeding any ordinary steel. Its fatigue resistance is exceptional. And above all, because of close control and a strict schedule of testing, these qualities are the same in mile after mile of wire.

Purple-Strand quality, however, does not end with the premium-price steel. Every step in the making of a Purple-Strand wire rope involves extra skill and attention. For example, design has been perfected until this line is a real precision machine. Lubrication has been studied and special lubricants developed. Every conceivable step has been taken to make Purple-Strand Form-Set the finest wire rope money can buy.

Bethlehem wire rope is available through distributors. Write Bethlehem Steel Company, Bethlehem, Pa., for the names of wire-rope distributors in your vicinity.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

For your convenience in writing to Bethlehem Steel Company, you will find a card bound in this issue.

AQUEDUCT REVIEW

(*Continued from page 256*)

switch consisted of a short double-track assembly, welded together complete with frogs and switches, and arranged to slide on top of the regular track. Loaded cars were simply shunted around a line of empties. As the heading advanced, the switch was moved forward.

Tunnel tracks built to 36-in. gage with 40-lb. rails were adopted as standard. Traffic protection was provided by automatic or hand-operated block signals. Power units for haulage were 8-ton battery and a few trolley type electric locomotives. All-metal side-dump cars with capacities of 4 to 6 yards were used. Excellent ventilation was maintained by surface operated fans arranged to exhaust or blow through 22-in. metal pipe.

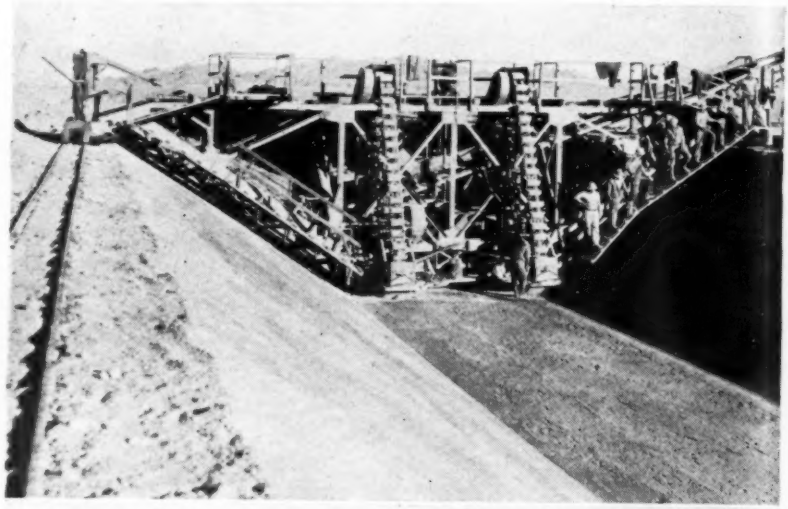
Tunnel Lining Methods

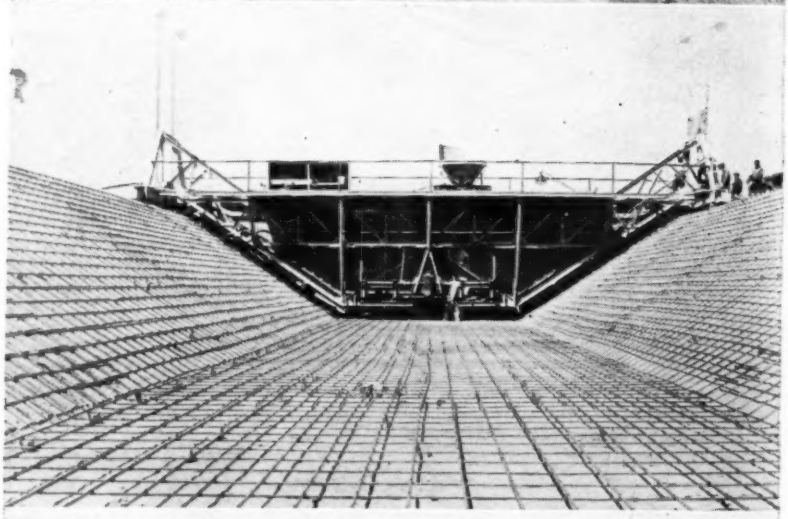
Steel forms were required for placing all tunnel lining. Carriage-mounted collapsible forms were generally used which could be moved ahead when collapsed through other forms not yet ready to be removed. The most common type of form was jointed at the top and at each side on the bottom. The two halves of the bottom folded up, allowing the sides to swing inward. It was raised and lowered and placed by a hydraulic jack mounted on a carriage which ran on the tunnel track.

Concrete aggregate for the tunnels, as well as for the other aqueduct features, was for the most part taken from pits located along the line. Screening and batching plants were located near the material pits, and cement in bulk was brought in by special trucks from the nearest railroad point.

For pouring the concrete lining, the general practice was to pour the arch first and then the invert, or floor, after the forms, track, pipe and wiring were removed. Concrete was batched outside the tunnels and brought in with batch cars, water being added at the point of placement. Air or plunger pumps forced the concrete into place through the top of the forms, the machines being moved

• Top: One type of canal trimmer. Note smooth accuracy of the cut. Center: Front view of canal paver that was developed on the aqueduct. This paver placed the entire lining, sides and bottom, at about one foot per minute. Bottom: Rear view of paver showing wooden frame work attached to rear of machine to support the hand finishers.





AMAZING DIRT MOVING CAPACITY

In Sand . . . Gumbo or Hardpan

● Five hundred yards an hour *casting*, or 300 cubic yards an hour *loading* . . . and more . . . are possible with the Austin-Western THREE-WHEEL Elevating Grader.

Outstanding among the many time and cost-saving features which contribute to this time-tested machine's amazing dirt moving capacity are: (1) Three-wheel design concentrates maximum weight over the plow, effectively counterbalancing the weight of the loaded carrier; (2) Hydraulic stiff leg forces the plow down to any depth required and holds it there; (3) Hydraulically operated furrow gauge wheel lets operator control width of the cut; (4) *Troughed* carrier operates at higher speed, handles a heavier load, and eliminates the need for friction-creating sideboards; (5) Hydraulic controls operate the massive parts with amazing speed and precision.

No matter whether you are operating in sand, gumbo or hardpan, you'll move more dirt at lower cost with an A-W Elevating Grader. Ask us to prove it! The Austin-Western Road Machinery Co., Aurora, Ill.

AUSTIN-WESTERN

Motor Graders
Roll-A-Planes
Rollers
Snow Plows

Crushing and Screening Plants
Washing Plants
Blade Graders

Motor Sweepers
Shovels and Cranes
Bituminous Distributors
Elevating Graders

5-Yard Tractor-Scraper
6-Yard Tractor-Scraper
8-Yard Tractor-Scraper
12-Yard Hydraulic Scraper

For your convenience in writing to The Austin-Western Road Machinery Co., you will find a card bound in this issue.

forward as the forms advanced. Forms were left in position from 10 to 12 hours. As much as 2,699 feet of arch and 12,220 feet of invert were placed in one week by a single plant. Concrete of 2,500 pound strength in 28 days was required. Actual strengths, controlled by frequent testing, everywhere exceeded the specifications.

Conduit Construction

Briefly described, the conduit is an unreinforced arch structure of horseshoe design, with inside dimensions of 16 feet high by 18 feet 10 inches wide at the base, with a minimum concrete thickness of 14 inches at the crown increasing to 4 feet at the invert line. The invert is 12 inches thick at the center and 22 inches at the edges. Each section contains 4.27 cu. yards of concrete per linear foot.

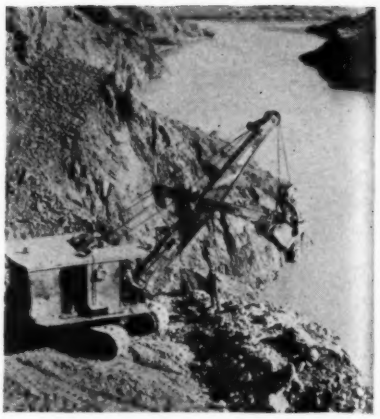
All trench excavation and backfilling was done with draglines, either Diesel or electric or Diesel-electric. The capacities varied from 2 to 6 yards, and both walking and caterpillar types were used. The material encountered in the excavation varied from fine sand to hard cemented sand and gravel which required blasting. About 10% of this material was classified as rock. The major portion of this was the hard cemented material and the rest was ledge rock. In level stretches the cut varied from 16 to 25 feet in depth. In rougher terrain and tunnel approaches cuts ran up to 65 feet, and in one place reached a maximum of 90 feet. No trimming was required for the trench sides, but the bottom was trimmed by hand.

The invert was placed from 3 to 7 days ahead of the arch to insure strength to support the arch forms and concrete. For placing the invert, machines similar to modern highway pavers were used.

Steel forms were required for both the inside and outside surfaces of the conduit arch. The inside forms were collapsible and the outside expansible. The outside forms were moved into place by an overhead gantry provided with hydraulic or screw jacks for raising and lowering the forms. The gantry traveled on rails laid along the edges of the invert and was self-propelled. The inside forms were moved by a carriage called a jumbo which traveled on track laid on the finished invert. It was likewise provided with jacks for collapsing and setting the wings of the form.

Handling the Concrete

Both paving mixers and transit mixers were used for mixing the concrete. Transit mixers, 4 yard capacity, were loaded at the batching plants and mixed enroute to the forms. Concrete was delivered to the forms by a variety of means. Hand pushed buggies, hoists, conveyors, and power-driven hopper cars were all used with satisfactory results. Concrete was not placed continuously, as in the tunnels. At the end of each day's pour, which varied from 105 to 210 feet, a steel bulkhead was provided. All arch concrete was adequately vibrated to insure compaction. All closed conduits were bulkheaded as soon as completed to prevent evaporation, and the interior surface kept sprinkled for 14 days. Water curing of outside surface was impractical because of high evaporation under desert conditions and scarcity of water. All exposed surfaces were therefore sprayed with two coats of coal tar sealing compound to hold in the original mixing water. Since the resultant black color absorbed heat, a coat of whitewash was sprayed on which reduced the temperature of the concrete by more than 20 degrees.

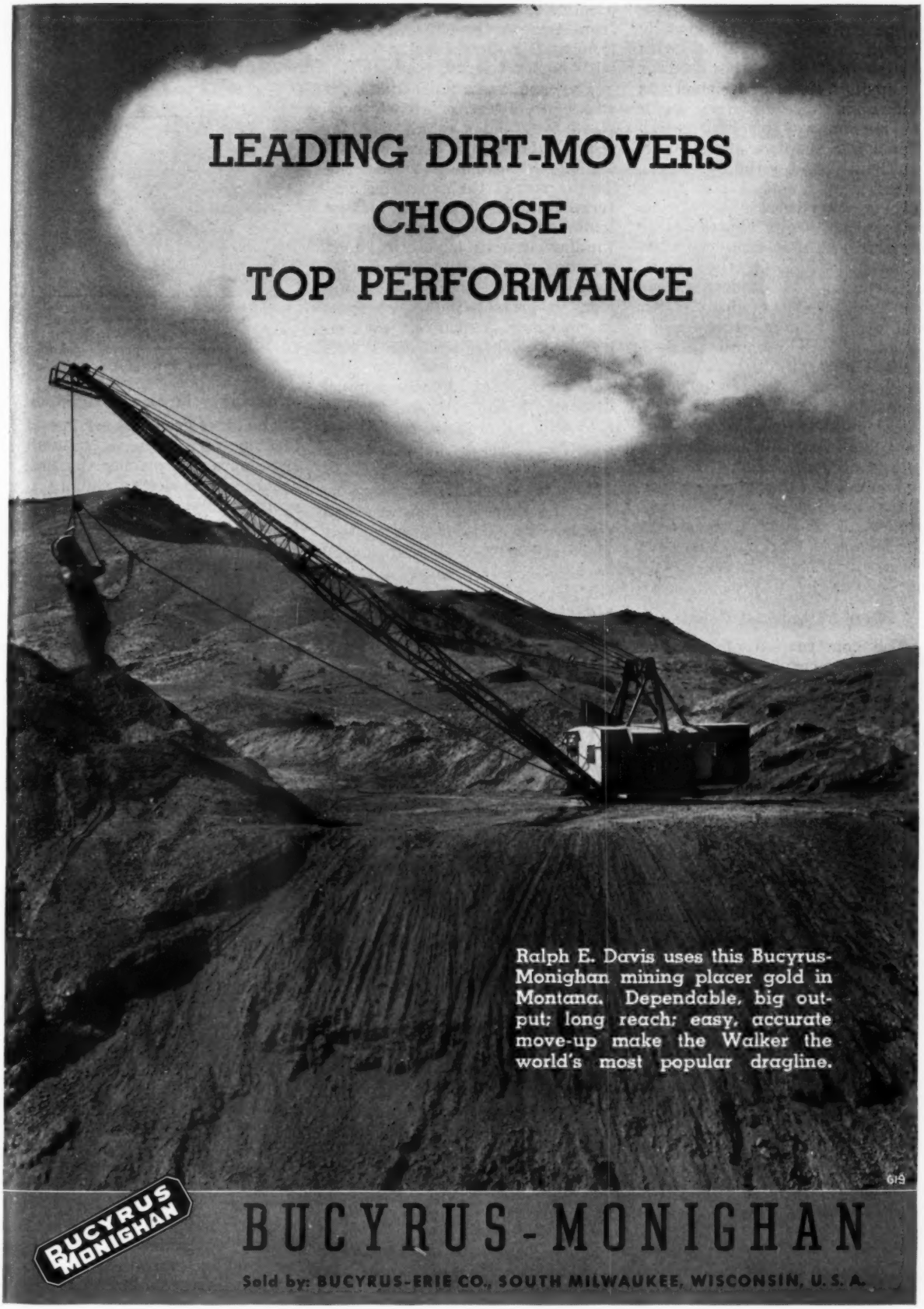


• Preparing to move the first dipperful at Parker Dam. About 2,235,000 cubic yards were excavated for this dam.

• Center gate of Parker Dam releases 25,000 cubic feet of water per second during a recent calibration test.

The construction of the conduit involved the excavation of 10,700,000 yards of common and 1,090,000 yards of rock, 7,000,000 yards of backfill, and 1,200,000 yards of concrete.

144 siphons are required on the main aqueduct for crossing drainage channels, ravines, and other depressions, and to cross artificial waterways for cross-drainage in flat country. They vary in length from 175 feet to 5 miles, with a total length of 29 miles. They are all of monolithic reinforced construction except at the Little Morongo Canyon, where 660 feet of 12-foot precast pipe was installed


LEADING DIRT-MOVERS
CHOOSE
TOP PERFORMANCE
Ralph E. Davis uses this Bucyrus-Monighan mining placer gold in Montana. Dependable, big output; long reach; easy, accurate move-up make the Walker the world's most popular dragline.
619
BUCYRUS-MONIGHAN
Sold by: BUCYRUS-ERIE CO., SOUTH MILWAUKEE, WISCONSIN, U. S. A.

For your convenience in writing to the Bucyrus-Erie Company, you will find a card bound in this issue.

as a test experiment.

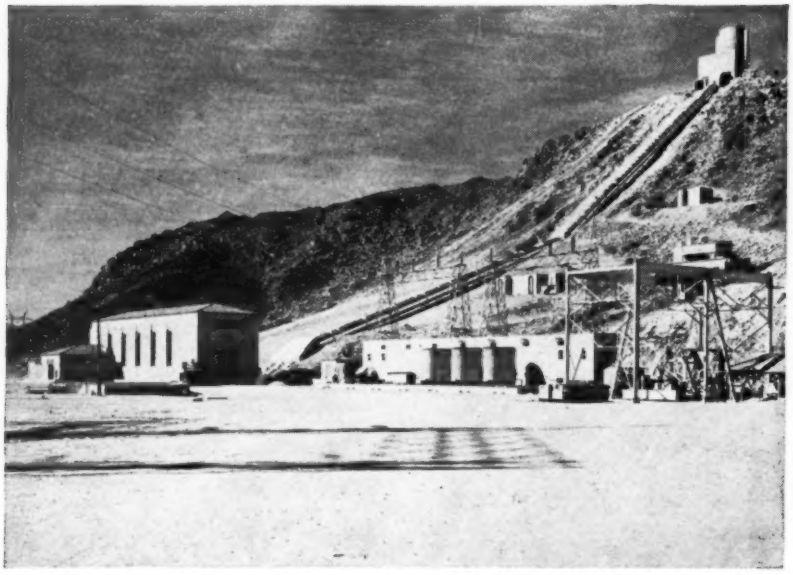
The entire barrel was usually poured in one operation with equipment similar to that used for the conduit. Reinforcing steel was made up in cages, and concrete for the bottom was placed through openings in the floor of the interior form. That for the barrel was placed from hoppers located on staging along the top of the outside form through chutes fitting the shape of the form. The most difficult problem in the siphon construction was encountered on steep, rough slopes where trucks and other equipment could not function. Handling was accomplished in such places by cableway, and cages held in place by anchor bars and cable anchored to the slope above. To provide flexibility and confine a possible rupture to a short section where the siphon crosses earthquake faults, the monolithic construction was broken at 20-foot intervals by special joints. For the most part, the construction of the siphons did not involve any unusual problems.

Over 62 Miles of Canals

The construction of the 62.8 miles of concrete lined canals on the main aqueduct attracted wide attention because of the pioneer development of trimming and placing equipment which made possible the progress of the work from two to three times faster than by any former methods, and with better results.

The canal has a finished bottom width of 20 feet, a top width of 55.13 feet, and a depth of 11.71 feet. Generally, the canal was not set in the ground to this full depth, part of the excavated material being used to build an embankment on each side, similar to familiar irrigation practice. Part of the excavated material also went to form a dike on the uphill side to protect the canal from storm water. A roadway was constructed on the other side. Where the aqueduct crosses washes which are part of the natural drainage of the country, canal is replaced by siphons which are constructed below the beds of the washes.

Rough excavation for canal offered no new problems and was particularly suited to dragline use. Machines with 1¾ and 2-yard buckets predominated, powered with gas or Diesel engines. Usually two machines were operated in echelon, each digging half of the trench as they progressed. On two of the contracts, however, most of the excavation was accomplished by a single electrically powered machine with a 5-yard bucket. Excavation by dragline was made as close as possible to finished lines since trimming had to be done by more expensive methods.



• Eagle Mountain pumping station, one of the five plants that will lift a billion gallons of water a day to a height of 1,617 feet.

• Placing 25 ton sections of steel pipe on a main distribution line. Sections were specially coated inside and out.

Accuracy in Slope Trimming

The chief problems for the contractor were those of trimming the slopes and placing the lining accurately to design rapidly and economically. Road grading and paving equipment could be used for the bottom but not for the sides. Hand methods were sure, but slow and costly. Experimenting with mechanization was also costly, and as it happened, those which failed did so chiefly because of efforts to avoid heavy first cost.

The first successful trimming machine, pioneered by Wood and Bevanda, resembled two ladder type ditching machines placed back to back, each completely trimming one-half the bottom and one side wall of the canal as it advanced. The whole assembly was supported by a steel bridge, the ends of which rested on railway trucks traveling on rails on each side of the canal. These rails were carefully set to the proper line and grade and controlled the accuracy of the trimming. The machine was driven forward as it excavated by means of power winches operating cables anchored ahead. Belt conveyors carried the excavated material clear of the canal.

Another type of trimmer also had a trussed steel frame which traveled on rails on each side of the canal trench. Instead of endless chains of digging buckets, however, it was equipped with blades similar to that of a road grader, which were lifted, lowered, or tilted by means of a system of jacks. The machine was hauled

WHY CORROSION SHORTENS THE LIFE OF WIRE ROPE

Number 1 in a series of informative articles for wire rope users, prepared by the Macwhyte Wire Rope Company

NO. 407

A. This wire rope was removed from service and stored for future use. Because the user forgot to lubricate the rope when put away, corrosion developed and ruined the rope. Proper lubrication would have prevented this.

B. This rope deteriorated early in service because it was not kept properly lubricated. Notice how corrosion caused the wires to become brittle and break up.

Cause of Corrosion

Corrosion of wire rope is caused by neglect, by leaving wire rope exposed to elements without complete protection.

Effect of Corrosion

If wire rope is allowed to corrode:

1. Tensile strength is decreased;
2. Resistance to fracture from bending is diminished;
3. Resistance to impact, or shock loading, is diminished.

If corrosion of wire, or rope, is allowed to continue for any period of time, the useful life of the wire rope is completely destroyed.

Remedy for Corrosion

Continual applications of an approved lubricant will prevent corrosion. Lubricant should be applied when the rope is placed in service, and periodically thereafter. If corrosion does get a start, immediate application of a good lubricant will retard further damage.

Active Ropes and Corrosion

Wire ropes in constant daily services are less likely to corrode than inactive ropes. At the first sign of corrosion, however, apply lubricant. It is well to lubricate ropes regularly, not only to prevent corrosion but also to reduce wear of both rope and equipment.

Inactive Ropes and Corrosion

Corrosion strikes inactive ropes quickly, unless they're adequately protected by thorough lubrication. Be sure your ropes are thoroughly lubricated immediately when taken out of service. This protects the entire rope against all elements; keeps the rope flexible, gives it a chance to live longer.

How Proper Lubrication Helps Wire Rope Resist Corrosion

Moisture, one of wire rope's worst enemies, will creep into the smallest opening and cause corrosion.

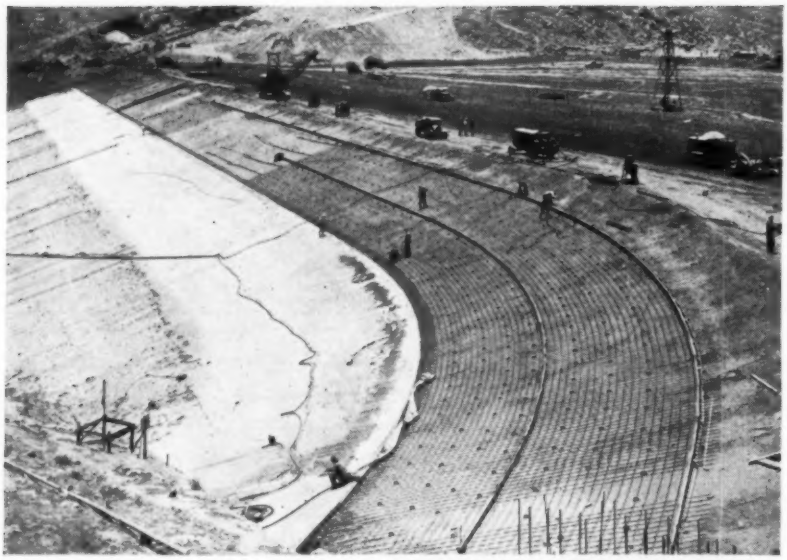
Therefore, choose a wire rope that has been thoroughly covered, inside and out, with proper lubrication; be sure to lubricate your rope pediodically. Then you will have fewer broken wires, fewer corrosion-fatigue cracks, less uneven wearing, etc.

(To protect your wire rope against corrosion use an approved lubricant like Macwhyte's special lubricant which, tests show, resists moisture, clings to, and protects the wires.

Reprints Available of this and other informative articles on wire rope. Simply address: Macwhyte Company, Kenosha, Wisconsin.

MACWHYTE COMPANY, Kenosha, Wis.
Manufacturers of PREformed, Internally Lubricated, Laboratory Tested, and Field Proved Wire Ropes, and Braided Wire Rope Slings for every use. New York ... Pittsburgh ... Chicago ... Ft. Worth ... Portland ... Seattle ... San Francisco. (Distributors throughout the U. S. A.)

For your convenience in writing to Macwhyte Company, you will find a card bound in this issue.



• Cajalco Dam. Constructed of compacted earth fill with concrete blanket on water face. It is over a mile long.

back and forth by a tractor in the canal trench, making a light cut each time until the finished grade was reached. The excavated material was pushed to the bottom of the trench by the blades and removed by bucket elevators and belt conveyors.

Both of these machines, as well as others built on the grader principle, operated satisfactorily and economically.

Reinforcing steel for the lining was placed by hand, practically the only hand operation in the canal construction. The steel was laid on precast concrete blocks placed on the subgrade.

Canal Paving Machine is Pioneered

The type of canal paving machine finally adopted by all the contractors was also pioneered by Wood and Bevanda. Basically, it was simply a giant trowel formed of steel plates fastened to a heavy steel framework and shaped exactly to the dimensions of the finished lining. This machine traveled on the same tracks as the trimmer and was drawn by winch and cable at the rate of about one foot a minute. Two paver type concrete mixers fed by a fleet of batch trucks kept pace along the roadway, and a gasoline driven car shuttled back and forth across the deck of the paving machine receiving concrete from the mixers and distributing it along the forward edge of the trowel. A ribbon of completed lining flowed from under the trailing edge of the machine, requiring only finish steel troweling to produce the surface desired. Several light wooden frames were usually drawn behind the paver to support the finishers on this work.

The 62.8 miles of canal required 7,773,000 cu. yards of excavation and 466,000 cu. yards of concrete.

Cajalco Reservoir, the principal storage unit of the aqueduct, is formed by an earth dam at its western edge across Cajalco Creek, and an earth dike, more than a mile long, on its northern boundary. Both dike and dam were constructed of selected and compacted earth fill, material for which was obtained from barrow pits within the reservoir site. The water face of each is protected by a concrete blanket, heavily reinforced with high-elastic-limit steel to prevent the formation of shrinkage or temperature cracks. 7,015,000 cu. yards of fill were required, and 951,000 yards of excavation. No borrow pit excavation was permitted within one-half mile of the dam or dike. Material was excavated by shovels, transported to the fills in 10-yard trucks, and spread and rolled in 6-inch layers. Spreading was done with 11-foot bulldozers and motor graders and compacted with sheeps-foot tampers, drawn three in tandem by 75 hp. tractors. Densities in compacted fill ranged from 110 to 133 pounds of dry material per cu. foot, and percolation through the compacted fill is negligible. Thorough tests for compaction, percolation, and penetration were made in a laboratory located on the site.

Parker Dam

The contract for constructing Parker Dam was let by the Bureau of Reclamation to the Six Companies, Inc., who in turn sublet the contract to J. F. Shea and Co., Inc. Two 29-foot tunnels were first constructed to divert the water around the damsite. Because of the great depth of silt deposited in the river bed here, excavations to the depth of 250 feet had to be made to reach a solid foundation. In consequence, a large part of this very high dam is below ground. About 2,295,000 cu. yards of excavation was required for its construction, and 332,000 yards of concrete. A power house will be built just downstream from the California abutment, the substructure of which was constructed at the same time as the dam to serve as a cofferdam around the wheel pits. The cost of the power house construction is to be divided equally between the District and the Bureau of Reclamation. It will eventually house four generators of 25,000 kw each.

Distribution Tunnels

The method of driving the distribution tunnels was similar to that used on the main aqueduct, but concrete placing methods differed. As these tunnels were circular it was not convenient to divide pouring operations into arch and invert, and this, together with the smaller diameter, 10 feet, required special equipment. A narrow traveling truss 160 feet long handled 70 feet of forms. One end of this truss rested on the completed lining and the other on a track in the floor of the unlined tunnel, bridging the section where concrete was being placed. Forms were shifted forward from completed work by trolleying along the truss. As the truss and its 70 feet of forms advanced, the track in the tunnel was taken up. An-

This job's as good as done. We're using Hercules!

HERCULES POWDER COMPANY
Incorporated
972 KING ST., WILMINGTON, DELAWARE

Please send information on Hercules Explosives.

Name _____

Street _____

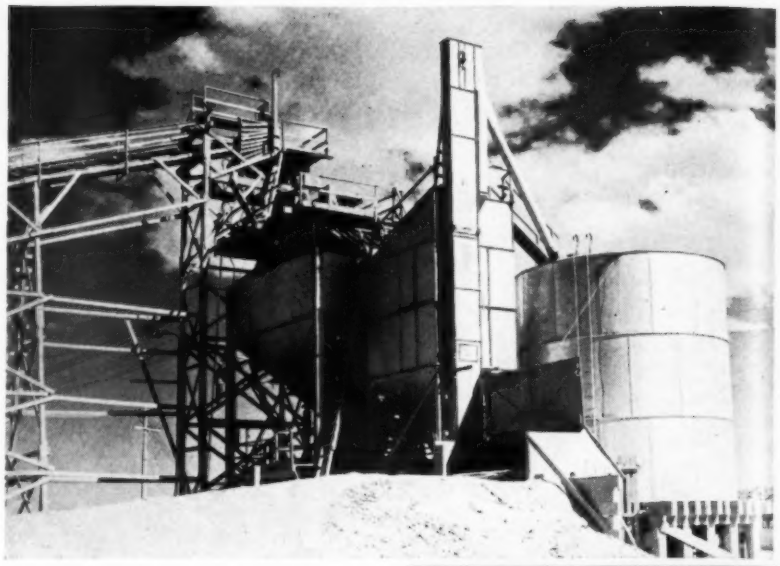
City _____ State _____ A-79

For your convenience in writing to the Hercules Powder Company, you will find a card bound in this issue.

other variance from main aqueduct procedure was that pouring was not continuous, bulkheads being placed at the ends of each day's pour, as in the conduits.

The greater part of the main distribution line is made up of precast concrete pipe and steel pipe. The 36 miles of precast was placed in sections 12 feet in length, a foot thick, 9 feet 8 in. to 12 feet 8 in. in diameter, with 2½ tons of reinforcing steel, and the whole weighing around 42 tons. These were the largest precast sections ever used, and special plants were required for their fabrication. Each of the 3 plants constructed by the contractors included equipment for making the steel reinforcing cages, mixing and placing plant, and curing yards.

The cages were set up inside vertical steel forms and the concrete poured from a hopper with a revolving spout. Special vibrating equipment and procedure was worked out to obtain the required compaction. Long revolving steel rods were inserted between the forms and worked back and forth continuously. After casting, the inside of the sections were steam cured for 3 or 4 hours. Forms were removed after 24 hours and the outside of the pipe immediately given a coat of curing compound followed by a coat of whitewash. The sections were left standing on the casting ring for three days, during which time the inside was kept wet, and then tipped horizontally and rolled onto racks in the curing yard where they were sprayed for 11 days.



• One of the batching plants on the main line. Aggregate of excellent quality was available from deposits near the aqueduct.

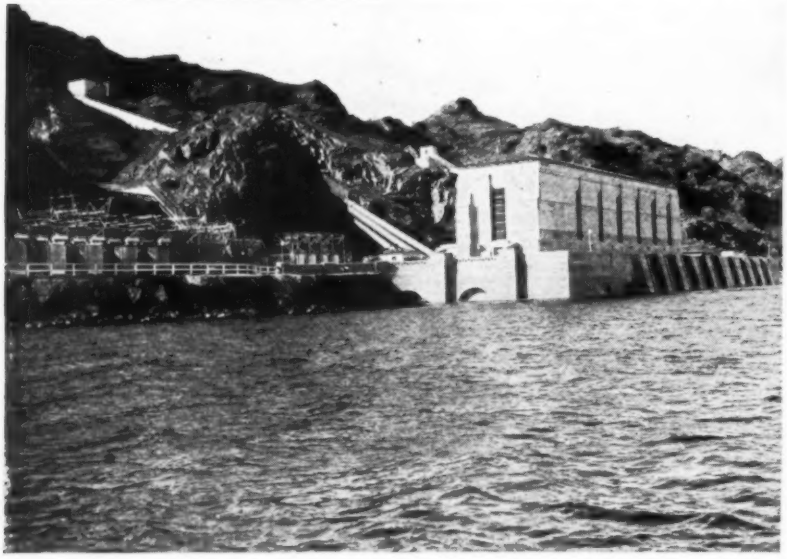
Various Handling Methods

Special low-swung trucks transported them to the trench where they were placed with special equipment. One contractor used a stiff-legged derrick mounted on a girder bridge spanning the trench and resting on rails. Another employed a truss bridge spanning the trench and running along rails on the bank, which dropped the section into place through a well in the center by means of an overhead crane. Rapid progress, as high as 360 feet a day, marked the placing of the line.

Where the line crosses the Santa Ana River valley, 10.3 miles of steel pipe was used. This pipe was made in 33 foot sections and given a ⅛ inch bitumastic enamel inside coating. The method of applying the enamel was by centrifugal spinning. A wire reinforcing fabric was then placed around the outside and a 1-inch coat of gunite applied. The weight of each section after guniting was about 25 tons. After curing, the sections were transported to the trench and placed with cranes. Joints were electrically welded, no rivets being used on the entire line. This work progressed at the rate of about 1,400 feet per week.

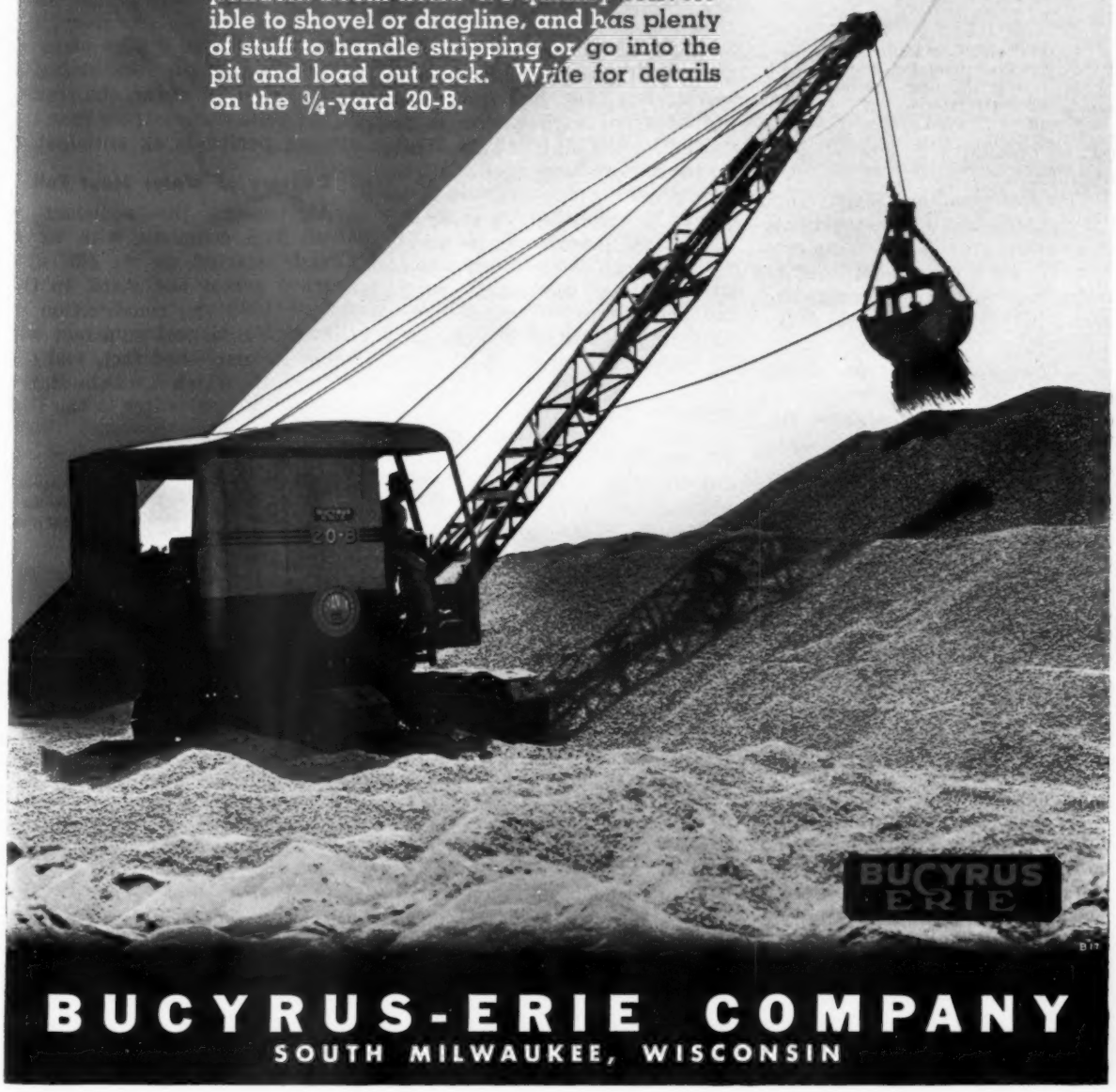
From the main distribution line, feeder lines will deliver the water to the various parts of the District. The initial plan includes 3 feeder lines from which the system may later be expanded indefinitely as need arises. Work is now under way on this final feature of the aqueduct construction, 51-inch steel pipe lined with centrifugally applied mortar and

• Intake pumping plant, located two miles above Parker Dam, starts the 400 mile journey of water drawn from the Colorado River.



Savings on the Stockpile

It's fast on the swing and the hoist . . . It's not tied down to tracks but can move to any part of your plant in a hurry . . . It's economical to run and will stand up to the toughest work you can give it . . . You can get it with high-speed, independent boom-hoist. It's quickly convertible to shovel or dragline, and has plenty of stuff to handle stripping or go into the pit and load out rock. Write for details on the 3/4-yard 20-B.



BUCYRUS-ERIE COMPANY
SOUTH MILWAUKEE, WISCONSIN

For your convenience in writing to the Bucyrus-Erie Company, you will find a card bound in this issue.

• The first water flows into Gene Reservoir from the intake tunnel. This is the first reservoir in the aqueduct system.

coated outside with gunite being installed.

The five pumping plants that lift the aqueduct water constitute the world's greatest pumping system. No such large quantities of water have ever been pumped to such heights. No such large amounts of power have ever before been applied to one job of pumping, nor have such amounts of power ever been generated and transmitted such long distances for one type of service.

The source of supply at Boulder power plant for the present pumping installation, 600 cu. ft. per second, is two 82,500 kva generating units capable of turning out 230,000 horsepower. The transmission line, 237 miles long, operates at 230,000 volts, the second highest in the world, Los Angeles being the highest with 287,000 volts.

Intensive Hydraulic Research

To work out the most efficient pump for the job, the District built a hydraulic laboratory at the California Institute of Technology and for four years, 1934-1938, carried out a program of intensive experimentation and research. As a result, a single stage pump design was adopted which gives the cheapest mechanical arrangement and the highest hydraulic efficiency of any large pump ever built.

The motors for such pumps were a difficult problem in themselves. A 12,500 h.p. continuous output from each motor is required for the highest lifts. While larger motors have been built, no power system has ever been designed to supply energy solely for such large motors over long high voltage lines. Then in order to be sure that each part of the pumping plant would be correctly coordinated, a system of automatic control was designed. Great care had to be taken to insure against damage from the enormous energy when starting or stopping. Within 15 seconds after the operator turns the switch on the remote control board the motor and pump is brought up to full speed, the discharge vaive opened, and a flow of 200 cu. feet of water per second (90,000 gallons per minute) is established from the single pump. At the same instant, the great turbines at Boulder power plant automatically open their gates and permit the passage of more water. Such a complicated sequence could not be handled with safety by manual control. Therefore, electrical and mechanical devices, minutely exact, are arranged to control these forces.

The five plants will lift a billion gallons of water per day 1,617 feet. Each plant is equipped with three pumps, each driven with a separate motor. Eventually each plant will have 9 pumping units.

Every possible test has been conducted in the laboratory, the field, and at the Intake plant to prove the accurate functioning of every detail. Thus far, the results of the tests demonstrate that the system performs as anticipated.

Delivery of Water Next Fall

At present the aqueduct is about 93% complete, with water already started on its 392 mile journey across the state. In the fall of 1939 the construction of the world's largest aqueduct will be an accomplished fact, and the purpose for which it was built, the delivery of vital water to the District cities, realized.

• Another view of Gene Reservoir showing the 140 foot high Gene Dam holding back the water that will be released this fall.

ROEBLING

The pacemaker in wire rope development

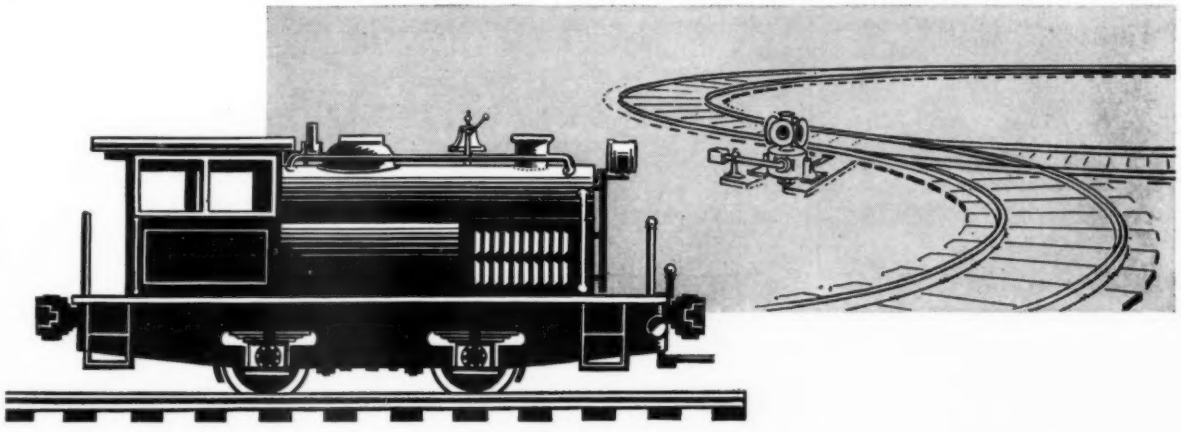
WIRE · Wire Rope · Welding Wire · Flat Wire · Bare and Insulated Wires and Cables · Wire Netting and Cloth. John A. Roebling's Sons Co., Trenton, New Jersey.
Branches in Principal Cities

JAR

You can get TWICE the Production WITH 1/4 YOUR PRESENT TRUCKS

You can eliminate 75 per cent of your heavy investment in trucks with the Brooks Load-Lugger, wherever loading is done by hand. Decrease truck operating costs . . . eliminate wasted standing idle time. ONE Load-Lugger and 4 to 8 Load-Lugger Buckets can do the work of a number of trucks . . . with far greater production and at much less cost. Write for the complete cost-cutting story. Demonstrations arranged in most sections.

BROOKS EQUIPMENT & MFG. CO.
98 Davenport Road, Knoxville, Tenn.



DIESEL OR
GASOLINE MECHANICAL DRIVE
▪
DIESEL OR
GASOLINE ELECTRIC DRIVE
▪
ELECTRIC STORAGE BATTERY
▪
ELECTRIC TROLLEY

The Whitcomb line of internal combustion and electric locomotives combined with a complete line of Baldwin steam locomotives, permits us to offer the best type of power for your service.

Let our engineers survey your requirements and give you their unbiased recommendations. No obligations of course.

The Whitcomb Locomotive Company (Plant at Rochelle, Illinois). All sales and engineering by The Baldwin Locomotive Works, Paschall Post Office, Philadelphia, Pennsylvania.

WHITCOMB LOCOMOTIVES

SUBSIDIARY OF THE BALDWIN LOCOMOTIVE WORKS

For your convenience in writing to the advertisers on this page, you will find a card bound in this issue.

Field Notes

(*Continued from page 263*)

rock quantities to be encountered) was made as a **positive assertion,** and made under such circumstances, or with such accompanying assurances, as justified plaintiff in relying thereon, without investigation on his part." The court added:

Rule Works Both Ways

"While the facts in the instant case present an instance of hardship and misfortune, it is one where, having made an express contract fixing his liability, the law can afford appellant no relief. If under said contract, appellant had encountered less solid rock excavation, instead of more, than the quantities stated in the estimates of the Highway Department, manifestly the State would be in no position to reduce its payment to him below the contract price. Consequently Powell is in no position to claim an increase over that amount."

The court also intimated that an independent and insurmountable obstacle to recovery by the contractor lay in a provision of the Texas constitution, forbidding payment of extra **compensation** to public contractors. But we do not understand that the court questions the right of such a contractor to **damages** for extra work necessitated by a breach of positive representations made to him, as a basis for his bid, as to subterranean conditions.

Arthur L. H. Street
Attorney at Law.

• **The Gordon Construction Company of Denver, Colorado, is also in the sand and gravel business. During construction work on the city hall at Denver, loading of the firm's dump trucks at the plant was greatly facilitated by the use of a concrete arch under the storage pile with loading chutes at convenient intervals along the tunnel.**

Handy Method for Cleaning Long Lengths of Heavy Chain

Light chains are cleaned readily of grease accumulations by dropping them into a pail or other suitable container filled with the usual light cleaning oil. Longer lengths of heavier chain, however, are not so readily cleaned and oiled. When blown off with a steam jet on some flat surface, only one side of the links are cleaned necessitating a great deal of pulling and rolling.

Regardless of whether steam or oil is used for cleaning, the chain can be handled more readily if two notched boards are driven into the ground to hold the chain in position. Thus, the chain can be moved along easily as each section is cleaned. To avoid a re-accumulation of dirt the chain can be run directly from the wooden supports into a container. *Frank Bentley.*

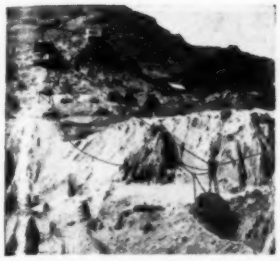
• **The notches in the boards keep the chain from slipping as each section receives attention. Note how the cleaned chain is dropped into the box.**

1938 Accident Record

The United States cut its accidental death toll by 10,200 in 1938—the greatest improvement ever recorded in a single year. The 1938 total was 95,000—the lowest since 1933 and a 10 per cent drop from the 1937 death total of 105,205.

Moreover, 700,000 fewer persons were disabled by injuries in 1938 than in 1937, and the economic loss from accidental deaths and injuries was cut by $400,000,000. The 1938 figure for injuries was 9,200,000 and the economic loss was $3,200,000,000.

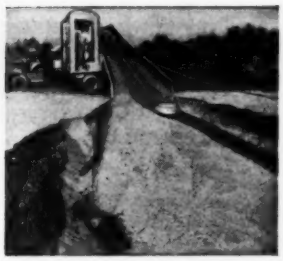
The improvement was general in every phase of accidents except in the home. For the first time in 10 years, the home accident death toll exceeded the nation's traffic toll. The greatest previous decrease in accidental deaths in the country was in 1919, when the total was 9,600 below 1918.



The picture above shows a Sauerman Slackline Cableway reclaiming mine tailing and delivering to bin on hillside 1,000 ft. from tailing pile. Material is dug, conveyed, lifted and dumped in a straightline operation.

Costs Reduced
. . . ON TOUGH EXCAVATING JOBS

Wherever there is a problem of moving earth, gravel, clay, coal, loose ore, etc., a distance of a few hundred feet, it is likely that the work can be handled at lowest cost with either a Sauerman Cableway or a Sauerman Drag Scraper. The first cost of a Sauerman machine is less than that of any other equipment of equal range and capacity. Moreover, a Sauerman machine is easy to operate and demands little by way of maintenance. Total operating expense is only a few cents per cubic yard handled. Write for Catalog.



Sauerman Drag Scrapers are used to dig and haul materials to a crusher or hopper—to stockpile surplus products—to load materials from a pit, bank or storage pile direct to trucks. A truckloading setup is shown above.

SAUERMAN BROS., Inc., 474 S. Clinton St., Chicago

ROGERS TRAILERS *EMBODY THESE* 3 ESSENTIALS

LOADABILITY—Quick, easy loading due to extremely low construction.

HAULABILITY—Lightness with strength, permitting speedier travel at less cost.

BRAKEABILITY—Safe, dependable control at all times due to the new equalizing brakes.

EXPERIENCE *built it* • ROGERS BROTHERS CORPORATION 136 Orchard St., Albion, Pa. • PERFORMANCE *Sold it*

WILLIAMS *Buckets*

Built by WELLMAN
Built to Last—and Move Dirt Fast

• Profits from a digging or material handling job often depend on how fast the crane operator can move dirt and materials. That's when Williams Buckets prove their advantages. Their tremendous digging power and ability to stand up do not rely on cumbersome weight and massive construction. No "dead-head" metal rides in Williams Buckets—you carry maximum yardage in every swing, utilizing the full capacity and range of your crane to move pay-dirt—not inert metal.

Send for free bulletins covering the Williams line of Power-Arm, Multiple-Rope, Power-Wheel, Hook-On and Dragline Buckets. Distributors located in all parts of the country for prompt field service.

THE WELLMAN ENGINEERING CO.
7002 CENTRAL AVENUE
CLEVELAND, OHIO

★ *Help Cranes Do Their Best Work!* ★

For your convenience in writing to the advertisers on this page, you will find a card bound in this issue.

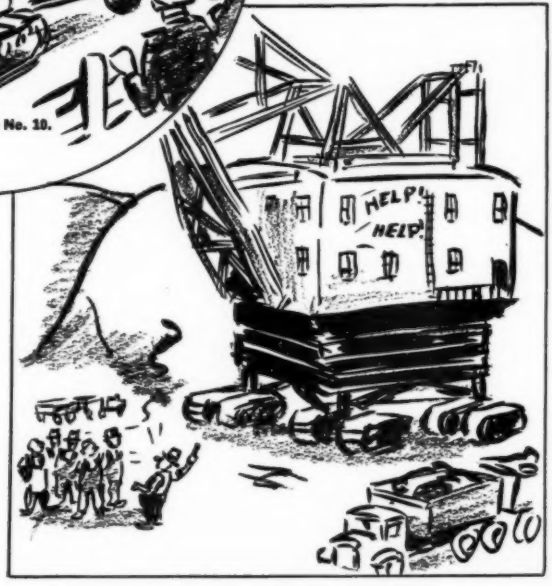
EX-LAFFS by Clement

That's Mortimer Bluepants.
He's above diggin' his own hole.

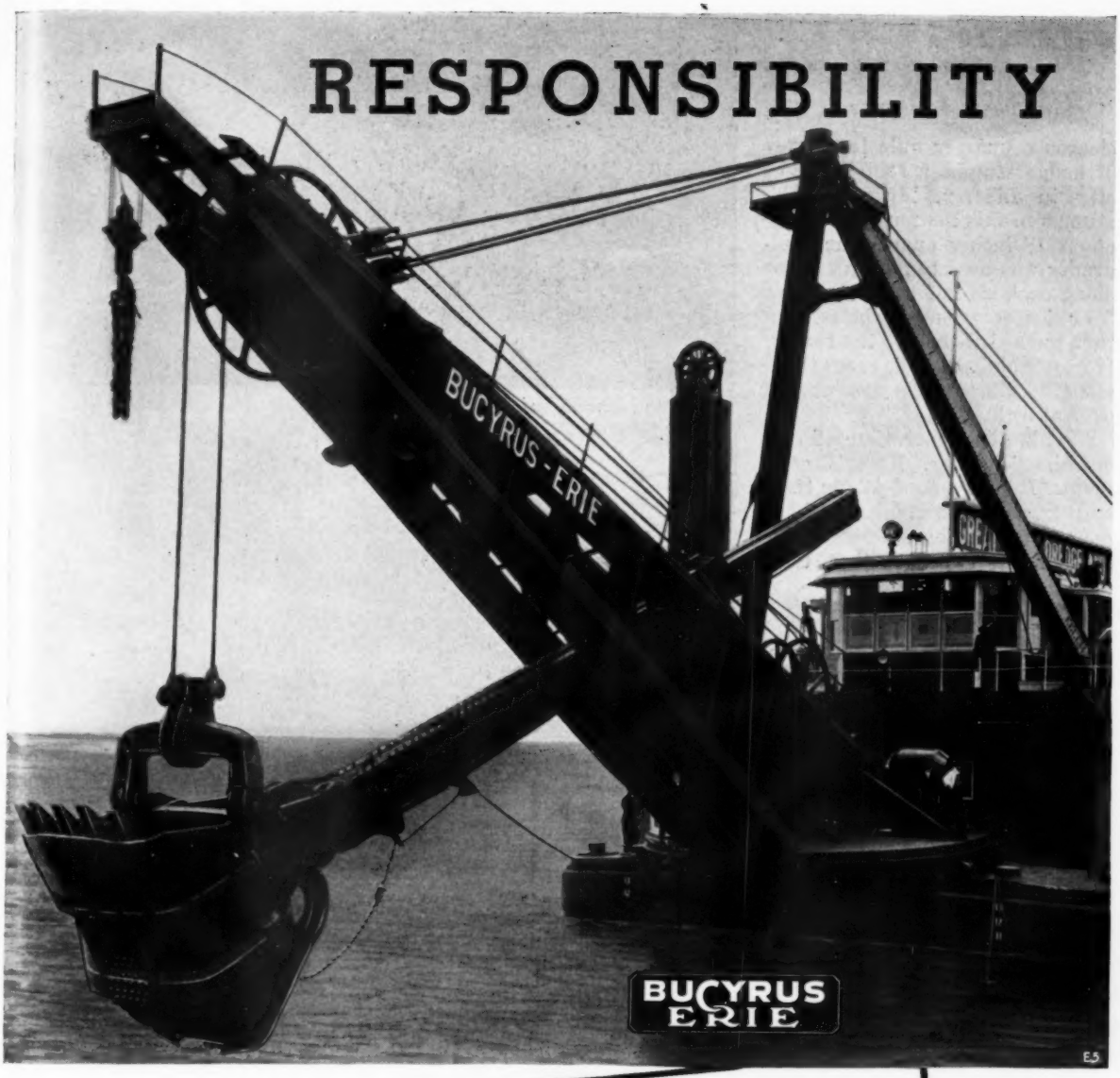
Blackie's awful superstitious.
Every time he spills a load, he
picks it up and throws it over
his shoulder.

I got two bucks on No. 10.
He's a cinch.

I tell ya boss I can't haul concrete today.
It's the little woman's wash day.



Men! Go in there and find that new operator
He's been lost for two days tryin' to get out.



In a single organization with 59 years of experience, Bucyrus-Erie can accept entire responsibility for your dredge, from first design to finished machine. The combined skill and experience of the largest staff of engineers and manufacturing men in the excavating field, working the most complete modern facilities in that field, are applied to give you exactly the RIGHT dredge for your work.

Write for latest bulletins on dipper, hydraulic, placer, or clamshell dredges.

Bucyrus·Erie

SOUTH MILWAUKEE, WISCONSIN

For your convenience in writing to the Bucyrus-Erie Company, you will find a card bound in this issue.

PUSHING 'EM OVER

(*Continued from page 259*)

cleared a quarter mile fence row of hedge stumps a foot in diameter in Liberty, Missouri. The stumps in this instance were only about 18 inches apart. The Bullgrader was used to plow a furrow along each side of the row, about 3 or 4 feet from the boles, and then pushed them into the furrow from one side. In some cases three and even four stumps were pushed over at a time.

"I like the operation of the machine," is Mr. Kirby's comment. "It does a good job on trees and from the digging we have done in connection with this work it looks like it can do that, too."

● Top: Showing a swathe cleared by the Bullgrader in the heavier growth areas. Bottom: Digging out the roots of a fallen tree with the grader blade.

HAYWARD BUCKETS

WON'T QUIT OR CAUSE TIME OUT

A Hayward Bucket keeps the job going ahead on scheduled time. It won't quit or cause time out.

THE HAYWARD COMPANY
52-54 Church Street
New York, N. Y.

Here Is a Bargain
in used excavating equipment

(taken from page 303)

BUCYRUS-ERIE 43-B Gas shovel. 22' boom, 17' dipper handle. 1½-yd. dipper. Chain crowd. Electric starter. Wisconsin 6-cylinder 6"x7" engine. Field reconditioned. Excellent shape. Located Boston. Box 2257

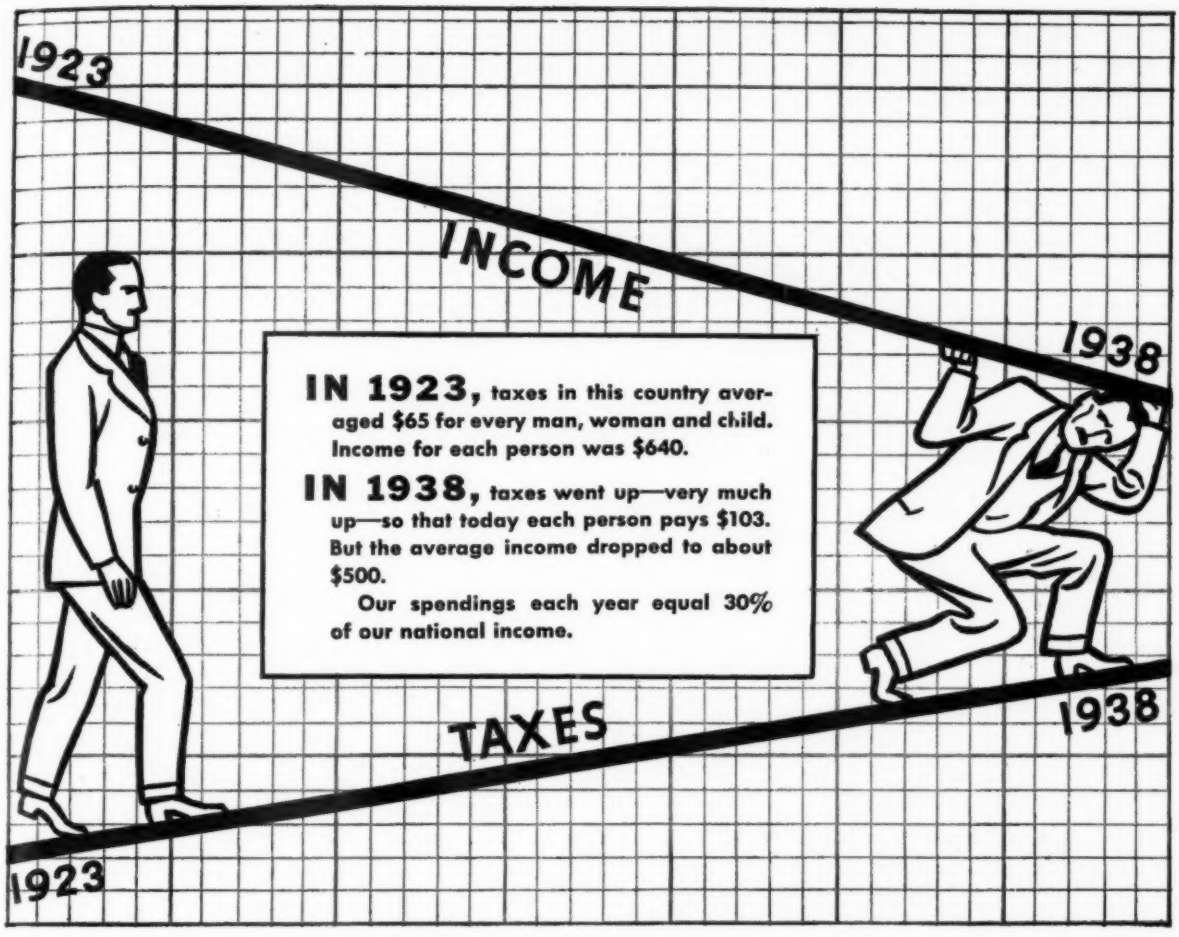
For other bargains in shovels, draglines, cranes, locomotives, trenchers, and miscellaneous contractors' equipment turn to page 303.

In Quicksand or Building sand

Owen Buckets Get A MOUTHFUL AT EVERY BITE

THE OWEN BUCKET COMPANY
6033 Breakwater Avenue Cleveland, Ohio
Branches: NEW YORK, PHILADELPHIA, CHICAGO, BERKELEY, CAL.

For your convenience in writing to the advertisers on this page, you will find a card bound in this issue.


1923
INCOME
1938
IN 1923, taxes in this country averaged $65 for every man, woman and child. Income for each person was $640.
IN 1938, taxes went up—very much up—so that today each person pays $103. But the average income dropped to about $500.
Our spendings each year equal 30% of our national income.
TAXES
1938
1923

CAUSE and EFFECT

Taxes Higher—Income Lower: Jobless—Still Jobless

TAX MONEY is necessarily "overhead" expense. It does not go into wealth-producing activities—into permanent productive jobs.

Every business has "overhead". It is not welcome, but necessary. When it gets out of hand, everyone suffers—employee, owner, manager. The sheriff constantly has his eye out for the business with out-of-control overhead.

Government expenses—and exclusive of relief—have increased tremendously. This overhead affects personal income, stability of employment and the chance for industry to expand and make more jobs.

It is difficult for a family or a business to bring outgo into line with income, by cutting out the near-essentials. But such cuts must be made if the family or a business is to evade the distress of bankruptcy.

It is even more difficult for the nation to undergo the painful operation. But its overhead can be cut without impairing the normal functions of government, and a move in that direction would do more to stimulate business activity than any other single thing.

If you do not act to this end through the men who represent you in Washington, taxes will continue up, income continue down—and the living standards of our people drop to those of other tax-ridden countries.

It is not yet too late—but it is very, very late!

GOVERNMENT SPENDING

1/4 OF OUR WORK DAY

This message is published by

NATION'S BUSINESS

—a monthly magazine edited in Washington where business and politics meet. Established 1912. 315,000 business men and women subscribe. Begin reading Nation's Business now.

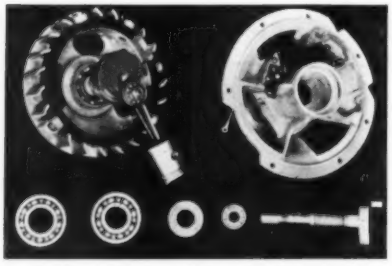
For your convenience in writing to the Nation's Business, you will find a card bound in this issue.

THREE GOOD REASONS

for using Homelite 3" Pumps

1 They're handy. Easy to get about. Each unit weighs only 91 pounds, complete with built-in gasoline engine. One man carries it—sets it up anywhere. It beats a larger pump to a job **by far**. You save time, **money.**

2 They're workers. A Homelite pumps 15,000 gallons per hour. It is self-priming—fastest you can get. Handles seepage automatically—keeps it at strainer level always. 28 ft. suction lift. Pumps water thick with solids without clogging. No manual attention necessary.



3 They're built. Homelites are rugged Special alloy construction—for strength and lightness. Only a few parts. Large open type impeller—mounted on engine shaft. Self-adjusting sealing rings. Heavy duty ball bearings. Gasoline engine is waterproof, weatherproof, and foolproof.

GET THIS BULLETIN NOW. Shows everything these low cost pumps can do for you. Write.

HOMELITE
CORPORATION

2295 Riverdale Ave., Port Chester, New York

Trade notes

Charles A. Higgins was elected president of Hercules Powder Company. The new president has been with Hercules since 1915 and has been vice chairman of the Executive Committee since 1933. He succeeds R. H. Dunham, who continues with the company as chairman of the Board of Directors, the position he has held jointly with the presidency since the organization of Hercules Powder Company in 1912.

Bucyrus-Erie Company, South Milwaukee, Wisconsin, is glad to announce the appointment of four new distributors who will handle shovels, draglines, clamshells and lifting cranes with capacities from ⅜- to 2¼-yards. The companies are:

1. The Beckwith Machinery Company, 6550 Hamilton Avenue, Pittsburgh, with branch offices in Bradford, Wilkes-Barre and Harrisburg, Pa.
2. The Great Lakes Supply Corporation, 324 West 36th Street, Chicago, Illinois.
3. The Fuchs Machinery and Supply Company, 1102 Farnam Street, Omaha, Nebraska.
4. The Quinn R. Barton, Inc., 1305 West Forsyth Street, Jacksonville, Florida.

Earl A. Banister was elected president of the Merritt-Chapman & Scott Corporation of New York. He succeeds the late Gwyn A. Whitney with whom he was associated for 25 years both in the Whitney Brothers Company of Duluth and after its acquisition by Merritt-Chapman & Scott Corporation. He has been an officer of the corporation continuously since the merger having held the offices of treasurer and more recently as executive Vice-President.

The Contractors Sales Corporation of Albany, New York, has taken over recently the central part of New York state in addition to the Albany territory as representatives of the Barber-Greene Company of Aurora, Illinois, manufacturers of portable and permanent belt conveyors, bucket loaders, bituminous mixers and finishers, snow loaders, coal handlers and ditchers.

The Ransome Concrete Machinery Company, Dunellen, N. J., announces the appointment of Servis Equipment Company, Dallas, Texas, to handle the entire concrete mixer and paver line in the counties surrounding Dallas.

F. L. Dake, for the past 21 years an executive of The Foote Company, Inc., announces his resignation as secretary and treasurer of that corporation. For a period of 33 years Mr. Dake has served the company in various capacities and for the past 21 years has been secretary and treasurer of same. Mr. Dake has devoted his entire business life to the paver industry and contributed in a very great measure to the success of The Foote Company, Inc.

Mr. A. H. Hinkle, Director of the Kentucky Rock Asphalt Institute, Louisville, Kentucky, has accepted a position with The Asphalt Institute as District Engineer, with offices at 1119 Chamber of Commerce Building, Cincinnati. He will take his new position on April 1.

Book reviews

The Harnischfeger Corporation, manufacturers of P&H cranes with capacities from 3 to 300 tons, announces the completion of Bulletin C-6 "Industrial Cranes," which covers completely the design and application of the line of P&H Industrial Cranes for general usage in industries the world over.

The Davey Compressor Company, Kent, Ohio, has just published the Davey "Air" Log, a 57 page presentation of the complete line of Portable Air compressors manufactured by the company.

A new 36 page catalog of technical books has just been issued by the Chemical Publishing Company, Inc., New York City. It covers domestic and imported books on metallurgy, machinery, engineering, general science, business, manufacturing formularies, technical dictionaries, mathematics, chemistry and physics. A copy will be sent to anyone interested on receipt of stamps to cover postage.

The Universal Crusher Company, Cedar Rapids, Iowa, has issued Bulletin No. 11 covering their line of Trailer Type Crushers. These Crushers are for tractors with rear power take-off and are used by contractors and highway departments for crushing hand-fed material from stock piles or windrows along the road to be surfaced. Copies are available on request.

Practical jobs for Diesel electric generator sets of from 20 to 80 Kilowatt capacity, are described in a new book, issued by Caterpillar Tractor Company. Manufacturing plants, towns, schools, hotels, mines, aviation fields and hospitals are among the many organizations that use "packaged power," either as standby or as the main power plant. The book illustrates many actual installations, and gives fuel and operating costs, quoted from owner's records. Copies of the booklet can be obtained, free of charge, by writing Caterpillar Tractor Company, Peoria, Illinois, and requesting Form 4658.

For your convenience in writing to the Homelite Corporation, you will find a card bound in this issue.

BUCYRUS-ERIE

Shovels — Draglines — Cranes — Clamshells — Dragshovels — Skimmers

Bullgraders — Bulldozers — Scrapers

BUCYRUS-ERIE COMPANY

Headquarters: SOUTH MILWAUKEE, WISCONSIN, U. S. A.
Works: South Milwaukee, Wis., Erie, Pa., Evansville, Ind.

ALABAMA, BIRMINGHAM: Bucyrus-Erie Company, 2212 Comer Building. Phone 3-0642.
MONTGOMERY: Ray-Ewbank Machinery Co., 101 Chandler St.
ALASKA: (See Washington, Seattle).
ARIZONA, PHOENIX: Arizona Tractor & Equipment Co., 1400 N. 19th St.
ARKANSAS, LITTLE ROCK: Lyons Machinery Company.
CALIFORNIA, LOS ANGELES: Crook Company, 2900 Santa Fe Avenue. Phone Kimball 5137.
SAN FRANCISCO: Bucyrus-Erie Company, 390 Bayshore Blvd. Phone Atwater 2341.
OAKLAND: Industrial Equipment Co., Outer Harbor.
COLORADO, DENVER: Ray Corson Machinery Co., 1646 Wazee Street.
CONNECTICUT, NEW HAVEN: The W. I. Clark Co., 1811 Dixwell Avenue.
FLORIDA, JACKSONVILLE: Quinn R. Barton, Inc., 1305 W. Forsyth St.
GEORGIA, ATLANTA: W. C. Vines, 1143 Briarcliff Road. Phone Hemlock 8376.
ATLANTA: R. S. Armstrong & Bro. Co., 676 Marietta. Phone Jackson 2010.
IDAHO, BOISE: The Inter-Mountain Equipment Co., Broadway at Myrtle Street. Phone 171.
ILLINOIS, CHICAGO: Bucyrus-Erie Company, 1312 Bankers Bldg., 105 W. Adams Street. Phone Franklin 5321.
CHICAGO: Great Lakes Supply Corp., 324 W. 38th St.
INDIANA, INDIANAPOLIS: A. F. Deaney, 719-721 N. Pine St.
IOWA, CEDAR RAPIDS: James W. Bell, 916—16th N. E.
KANSAS, PITTSBURG: Bucyrus-Erie Company, 209 East 4th St. Phone 164.
KENTUCKY, LOUISVILLE: Brandeis Machinery & Supply Co., Brook & Warnock Sts. Phone Magnolia 6600.
MAINE, PORTLAND: Maine Truck-Tractor Co.
MARYLAND, BALTIMORE: Stuart M. Christhilf & Co., 205 Snow Bldg. Phone Calvert 4310.
MASSACHUSETTS, BOSTON: Bucyrus-Erie Company, 240 N. Beacon St. Phone Stadium 3152.
MICHIGAN, DETROIT: Abrams-Anderson Co., 10425 Northlawn Ave.
MINNESOTA, CROOKSTON: Wm. H. Ziegler Co., Inc., 122 So. Main St.
DULUTH: Wm. H. Ziegler Co., Inc., 304 Lake Ave. So. Phone Melrose 681.
MINNEAPOLIS: Wm. H. Ziegler Co., Inc., 2331 University Ave. S. E. Phone Gladstone 7971.
MISSISSIPPI, JACKSON: Mississippi Road Supply Co. Telephones: Long Distance 9906. Local 3676.
MISSOURI, KANSAS CITY: Bucyrus-Erie Company, 1007 Fairfax Bldg. Phone Harrison 4811.
ST. LOUIS: Bucyrus-Erie Company, 818 Olive St.—Suite 906. Telephone Chestnut 1354.
MONTANA, BILLINGS: Connelly Machinery Co., 509 N. 27th Street.
GREAT FALLS: Connelly Machinery Co.
MISSOULA: Westmont Tractor & Equip. Co.
NEBRASKA, OMAHA: Cardinal Supply & Mfg. Co., Sunderland Bldg.
OMAHA: Fuchs Mchy. & Supply Co., 1102 Farnam Street.
NEVADA, RENO: Steiner Equip. Co., East 4th Street (P. O. Box 471)
NEW JERSEY, ENGLEWOOD: Bucyrus-Erie Company, 214-216 South Dean Street. Phone 3-6727.
NEW MEXICO, ALBUQUERQUE: R. L. Harrison Co., Inc., 209 N. 4th Street.
NEW YORK, NEW YORK: Bucyrus-Erie Company, 30 Rockefeller Plaza, Room 3627. Phone Columbus 5-4395.
NEW YORK: Tractor & Equipment Corporation, 355 Walton Ave. Phone Mott-Haven 9-5500.
SYRACUSE: Bucyrus-Erie Company, 303 Draper Ave. Phone 6-1078.
NORTH CAROLINA, GREENSBORO: E. F. Craven Company.
OHIO, CINCINNATI: Bode-Finn Equip. Co., Inc., 1650 Central Avenue.
MENTOR: Earl Ives Equipment Co.
OREGON, PORTLAND: Clyde Equipment Co., 17th & Thurman Streets. Phone Broadway 5561.
PENNSYLVANIA, PHILADELPHIA: Bucyrus-Erie Company, 821 Commercial Trust Bldg. Phone Rittenhouse 4281.
PITTSBURGH: Bucyrus-Erie Co., 1502 Clark Bldg. Phone Atlantic 4815.
PITTSBURGH: Beckwith Machinery Co., 6350 Hamilton Ave. Phone Montrose 4300.
TENNESSEE, KNOXVILLE: Brooks Equipment & Mfg. Co., 408-10 Davenport Rd.
MEMPHIS: Road Builders Equipment Co., 635 Union Avenue.
TEXAS, DALLAS: F. W. Knable, 1212 Magnolia Bldg. Phone 2-2943.
DALLAS: F. C. Crane Co., 3120 Grand Ave. Phone 4-2181.
EL PASO: Tri-State Equipment Co., 500 E. Overland Ave.
HOUSTON: Gulf Tractor & Equip. Co., 3100 Polk.
PECOS: Tri-State Equipment Co.
VERMONT, BARRE: Reynolds & Son, Inc.
VIRGINIA, RICHMOND: Virginia Tractor Company, Inc., 1628 W. Main St.
WASHINGTON, SEATTLE: Clyde Equipment Company, 3410 First Ave., South.
SEATTLE: Bucyrus-Erie Co., 3408 First Avenue South. Phone Maine 6424
SEATTLE (for Alaska): Northern Commercial Co., 419 Colman Bldg.
WEST VIRGINIA, CLARKSBURG: General Equip. Co., Inc., 414 N. Fourth St.
HUNTINGTON: Chas. S. Porter Supply Co., 424 Fourth Ave.
WISCONSIN, MILWAUKEE: W. L. Hartley, 3021 Woodland Ave., Wauwatosa, Wis.

CANADA

BRITISH COLUMBIA, VANCOUVER: Finning Tractor and Equipment Co.
MANITOBA, WINNIPEG: Kipp-Kelly, Ltd., 68 Higgins Avenue.
ONTARIO, TORONTO: F. H. Hopkins & Co., Ltd., Commerce & Transportation Building.
QUEBEC, MONTREAL: F. H. Hopkins & Co., Ltd., 340 Canada Cement Bldg., Phillips Square. Phone Plateau 1136.

FOREIGN DISTRIBUTORS

ARGENTINE REPUBLIC: General Electric S. A. Buenos Aires, Rosario de Santa Fe, Tucuman, Cordoba, Mendoza, San Juan.
BRAZIL: International Machinery Company, Rio de Janeiro, Sao Paulo, Recife.
BOLIVIA: International Machinery Company, Oruro.
CHILE: International Machinery Company, Santiago, Antofagasta, Iquique.
CHINA: (exclusive of Manchuria) AND HONGKONG: Messrs. Arnhold & Co., Ltd., Shanghai.
COLOMBIA: International General Electric S. A., Barranquilla, Bogota, Medellin, and Cali.
GUIANA—BRITISH: Booker Bros. McConnell & Co., Ltd., Georgetown, British Guiana.
HAITI, REPUBLIC OF: Anten Knesr, Port au Prince.
HAWAII: Theo. H. Davies & Co., Ltd., Honolulu.
HONDURAS: Mullen Tractor and Equipment Co., Inc., San Pedro Sula.
JAPAN: Mitsui & Co., Ltd., Tokio and principal cities of Japan.
MEXICO: Implementos Agricolas, S. A., Ave. Juarez No. 104A, Mexico, D. F.
PERU: International Machinery Co., Lima.
PHILIPPINE ISLANDS: Manila Machinery & Supply Co., Inc., Manila.
PUERTO RICO: West India Machinery & Supply Co., San Juan.
SALVADOR, REPUB. EL: Benjamin Sol M., San Salvador.
TRINIDAD, DOMINICA AND THE WINDWARD ISLANDS: Neal & Massy Engineering Co., Ltd., Port of Spain, Trinidad.
URUGUAY: General Electric, S. A., Montevideo.
VENEZUELA: International General Electric S. A., Caracas, Marcaibo.
VIRGIN ISLANDS: West India Machinery & Supply Co., San Juan, Puerto Rico.

For Bucyrus-Erie Tractor Equipment—Bulldozers, Bullgraders, Hydraulic and Cable Controlled Scrapers, See Your International TracTracTor Dealer.

RUSTON-BUCYRUS LIMITED

Headquarters and Works: LINCOLN, ENGLAND
London Office, Imperial House, 15, 17, 19, Kingsway, W. C. 2

AUSTRALIA: Ruston & Hornsby (Australia), Pty., Ltd., Melbourne, Sidney and Brisbane.
WESTERN AUSTRALIA: Messrs. Harris Scarfe & Sandovers, Ltd., Central Hay St.; P. O. B. 92, Perth.
BELGIUM: Messrs. Bergerat-Dutry, 21, Rue de la Senne, Brussels.
BRITISH ISLES:
BRISTOL: Ruston & Hornsby, Ltd., Scottish Widow's Buildings, 28 Baldwin St., Bristol, 1.
BRITISH NORTH BORNEO: The United Engineers, Ltd., Singapore.
BURMA: William Jacks & Company, P. O. Box 83, 517 Merchant Street. Rangoon, Burma.
DENMARK: E. T. Grew, Raadmansgade 43, Copenhagen.
EGYPT: The Tractor & Engineering Co., S. A. E., P. O. Box 366, Cairo.
ESTHONIA: Mr. V. M. Laussen, Roosikrantsi 3, Tallinn.
FEDERATED MALAY STATES: Harper-Gilfillan & Co., Ltd., P. O. Box 247, Kuala Lumpur, Selangor.
FIJI, TONGA, SAVAII & UPOLO: Morris, Hedstrom, Ltd., Suva, Fiji.
FINLAND: Aktiebolaget, Eskstroms, Maskinaffar, Helsingfors.
FRANCE: Messrs. Brunner & Marchand, 3 Rue de Stockholm, Paris 8e.
GREECE: Societe Financiere et Technique de Grece, S. A., Rue Metropole No. 10, Athens.
HOLLAND: Messrs. Wynmalen & Hausmann, Postbus 1216, Rotterdam.
HUNGARY: Internationale Maschinenhandels, V., Vilmos csaszar-ut 32, Budapest.
INDIA (WESTERN): Greaves Cotton & Co., Ltd., P. O. Box 91, Bombay.
INDIA (EASTERN): McLeod & Co., P. O. Box 78, Calcutta.
IRAN & IRAQ: Messrs. Stephen Lynch & Co., Ltd., Baghdad.
IRISH FREE STATE & NORTHERN IRELAND: Ruston & Hornsby, Ltd., Dublin
ITALY: Soc. An. Ing. F. Fiorentini & C., Via Tiburtina N. 364, Casela Postale 1159, Roma (38).
KENYA, UGANDA, AND TANGANYIKA: Messrs. Gailey & Roberts, Limited, Nairobi, Kenya Colony, British East Africa.
LATVIA: Argonaute—E. Meyer, Terbatas iela 9/11, Riga.
NETHERLANDS EAST INDIES: Lindeteves-Stokvis, J. A., Brouwersplein 29, Amsterdam, Holland.
NEW ZEALAND: John Burns & Company, Ltd., Customs Street, East, Auckland.
NORWAY: Maskin A/S Pay & Brinck, P. O Box 653, Oslo.
PALESTINE: Mr. A. Koch, Engineering Works & Supplies, P. O. Box 707, Jerusalem.
POLAND: Eugene Bojemski, Wandy 42, App. 9, Katowice.
PORTUGAL: Monteiro Gomes, Limitada, Rua Cascais, 47 Alcantara, Lisbon.
SIAM: Bangkok Dock Co., Bangkok.
SPAIN: Messrs. Gumersindo Garcia, Rodriguez Arias 1, Bilbao.
STRAITS SETTLEMENTS, SARAWAK AND BRITISH NORTH BORNEO: Messrs. The United Engineers, Ltd., Singapore and 87 Bishop Street, Penang.
SUDAN: Sudan Mercantile Company, Limited, P. O. Box 97, Khartoum.
SWEDEN: Tornborg & Lundberghs, A. B., Norra Bantorget 22, Stockholm.
SWITZERLAND: U. Ammann Maschinenfabrik, A. G. Langenthal.
TURKEY: Said Akinci ve Said Dormen, Galata, Bezkurt-Jeneral Han No. 4-5-6, Istanbul.
UNION OF SOUTH AFRICA: Hubert Davies & Co., Ltd., P. O. Box 1386, Johannesburg, Transvaal.
YUGOSLAVIA: Messrs. H. & Ch. Voegeli, P. O. Box 56, Pariska U. L. 7. Belgrade.
Local distributors in principal countries on the following continents: Europe, Africa, Asia (except Japan and China), Australasia and New Zealand.

BUCYRUS-MONIGHAN CO.

Works: Chicago, Ill.
Products sold exclusively by Bucyrus-Erie Company, Ruston-Bucyrus Limited and their distributors.

BUCYRUS ERIE

New Equipment

(Continued from page 267)

line engines or by Ingersoll-Rand type "H" oil engines.

In these new units a bell housing connection is used on all sizes, making compressor and engine practically one unit. The entire assembly is mounted on a sturdy pressed steel frame.

Thermostatic control replaces the adjustable curtain and automatically assures the correct cooling water temperature for the engine. A more convenient location is provided for the air receiver and fuel tank, the latter being lead-coated, easy to fill and sufficiently large to hold a day's supply.

Complete details, including a two-page chart for selecting the proper size compressor to operate various air tools, are available in a new thirty-two page booklet, form 3364. Copies may be obtained from the Ingersoll-Rand Company, 11 Broadway, New York City, or from any of the branch offices.

Improved Cord Air Hose

Several new improvements have been made in the design and construction of Great Seal Cord Air Hose, according to a recent announcement by New York Belting & Packing Company of Passaic, New Jersey.

Synthetic rubber has been adopted as standard construction for the tube, or lining. This, it is claimed, gives positive protection against deterioration of the lining as a result of handling hot oil. The cord principle of construction, similar to that used in the manufacture of tires, is continued, but an improved method of bonding the cord carcass to the tube and cover results in a greater degree of adhesion, the announcement added.

The improved hose includes the use of a special tan gum possessing increased abrasion qualities, and despite its toughness, it has a pliable texture which is helpful to the operator in gripping the hose.

24-Yd. Scraper

Continuing their movement toward larger pusher-loaded scrapers, R. G. LeTourneau, Inc. of Peoria, Illinois, have recently introduced their Model W Carryall Scraper rated at 23 yards heaped.

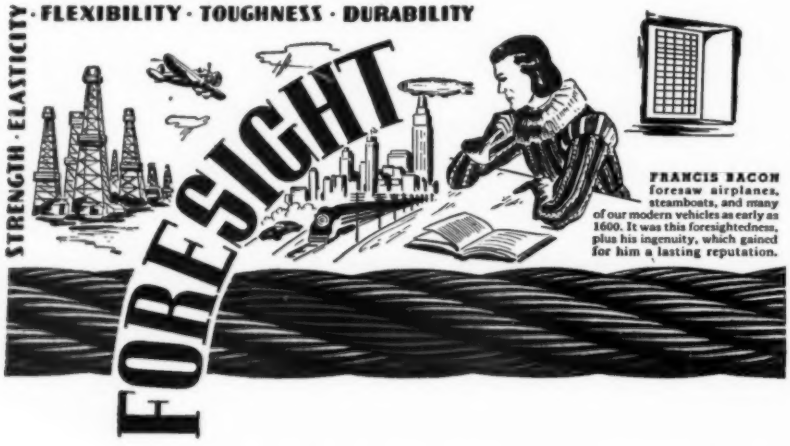
This extra-capacity Carryall has been designed especially to take full advantage of two tractors' horsepower for loading and one D8 "Caterpillar" in hauling. Although the Model W is particularly adapted for pusher work, it can be loaded without the aid of a pusher when favorable grade loading permits.

A number of features are embodied in this large Carryall that make it an extra-capacity unit: large, single bucket; special alternate curved and straight cutting blades placed at a plow-like, natural suction, digging angle for boiling loads in easier; positive, "wipe-out" ejection tailgate that quickly cleans the bowl of the most stubborn materials; and a new large sheave arrangement that reduces cable strain, facilitates load handling, and keeps the dirt out of the sheaves and the cable.

The bowl measures 10 feet deep, 10 feet wide and 5 feet high, giving a capacity of 23 heaped yards, according to the manufacturer.

The extra high sides retain the spill usually wasted over the edge in loading and turn it into additional pay yards.

STRENGTH · ELASTICITY · FLEXIBILITY · TOUGHNESS · DURABILITY



FRANCIS BACON foresaw airplanes, steamboats, and many of our modern vehicles as early as 1600. It was this foresightedness, plus his ingenuity, which gained for him a lasting reputation.

The ability to look ahead . . . to anticipate the future demands of the industries we serve . . . has contributed much to the reputation for quality which Leschen Wire Rope enjoys.

By studying trends, and preparing in advance for new developments, we have been able to provide a dependable wire rope for each new condition, as it arose.

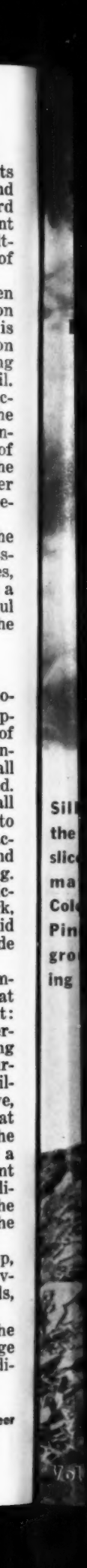
"HERCULES" (Red-Strand) Wire Rope itself was the result of just such foresight — a superior wire rope developed to efficiently and economically meet the more exacting requirements demanded by modern industry.

Expect more from "HERCULES" (Red-Strand) Wire Rope — you will get it.

In order to be suitable for all purposes, "HERCULES" (Red-Strand) Wire Rope is made in a wide range of both Round Strand and Flattened Strand constructions—all of which are available in either the Standard or Pre-formed type.

"HERCULES" (RED-STRAND) REG. U.S. PAT. OFF. WIRE ROPE

MADE ONLY BY
A. LESCHEN & SONS ROPE CO.
WIRE ROPE MAKERS · ESTABLISHED 1857
5909 KENNERLY AVENUE · · ST. LOUIS, MO.

NEW YORK . . . 87 to 90 West Street
CHICAGO . . . 810 W. Washington Blvd.
DENVER . . . . 1554 Wazee Street
PORTLAND . . 914 N.W. 14th Avenue
SAN FRANCISCO . . 520 Fourth Street
SEATTLE . . 3410 First Avenue, South

For your convenience in writing to A. Leschen and Sons Rope Co., you will find a card bound in this issue.